Factors Affecting Consumers Preferences for Specialty Eggs in Canada

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ABSTRACT

The past decade has seen a significant increase in the consumer demand for specialty eggs in Canada. This egg consumption trend has reflected the fact that current egg consumers are not only content about eggs as a staple, but also demand egg products with enhanced attributes, such as nutrition, health, animal welfare and food safety. A large body of literature has reported that consumers are willing to pay a premium for specialty eggs that embody value-added qualities. Thus, marketing information about heterogeneity in consumer preferences and characteristics when purchasing eggs is needed for developing effective marketing plans and serving consumers' needs.

In order to address this issue, a choice experiment approach is adopted to elicit respondents' preferences toward various characteristics of eggs and egg purchasing behaviours through an online survey of 647 egg consumers in Canada. Egg consumers were asked to make choices from three alternative egg products, or none, on the basis of five attributes including price, shell colour, production method, feed, and pasteurization. Additionally, to test an alternative production method (verified free run), I developed two versions of choice responses: one with verified free run, one with only free run.

Results show that Canadian consumers' willingness to pay for different types of egg attributes varies significantly, shell colour is found to be related to consumers' preferences for some credence attributes (including free run, organic and pasteurization). Compared to white regular eggs, respondents are willing to pay the most for white free run eggs (premium is $1.18 per dozen), followed by omega-3 enhanced eggs (premium is $ .57 per dozen), brown organic eggs (premium is $.52 per dozen) and brown free run eggs (premium is $ .57 per dozen), and are indifferent towards verified free run eggs, vitamin-enhanced eggs and white pasteurized eggs. In addition, consumers generally require a discount of $ .70 per dozen to purchase brown

pasteurized eggs relative to white regular eggs. Furthermore, results from the extended multinomial (MNL) model and the mixed logit (ML) model confirm the existence of preference heterogeneity for egg attributes amongst Canadian consumers.

Results from this study will not only help egg producers, retailers and other stakeholders to develop targeted marketing plans to expand choices within egg markets, but will also benefit egg consumers with different requirements for egg quality and egg attributes.

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CHAPTER 1
INTRODUCTION

1.1 Background

Per capita egg consumption declined beginning in the 1980s and continued to fall until 1995. An increased public awareness of the link between high cholesterol and egg consumption, and the salmonella scare contributed to the rapid decline in per capita consumption of eggs during this time in Canada (see Figure 1-1) (Brown and Schrader 1990; Schmit and Kaiser 1998; Sim and Sunwoo 2000; Hailu and Goddard 2004; Asselin 2005). Changing dietary culture and lifestyle (e.g. rising demand for healthy alternatives as well as novel and convenience foods) also contributed to the decline in egg consumption (Brown and Schrader 1990; Ness and Gerhardy 1994; Fearne and Lavelle 1996). However, since the middle 1990s, this downward trend has reversed.

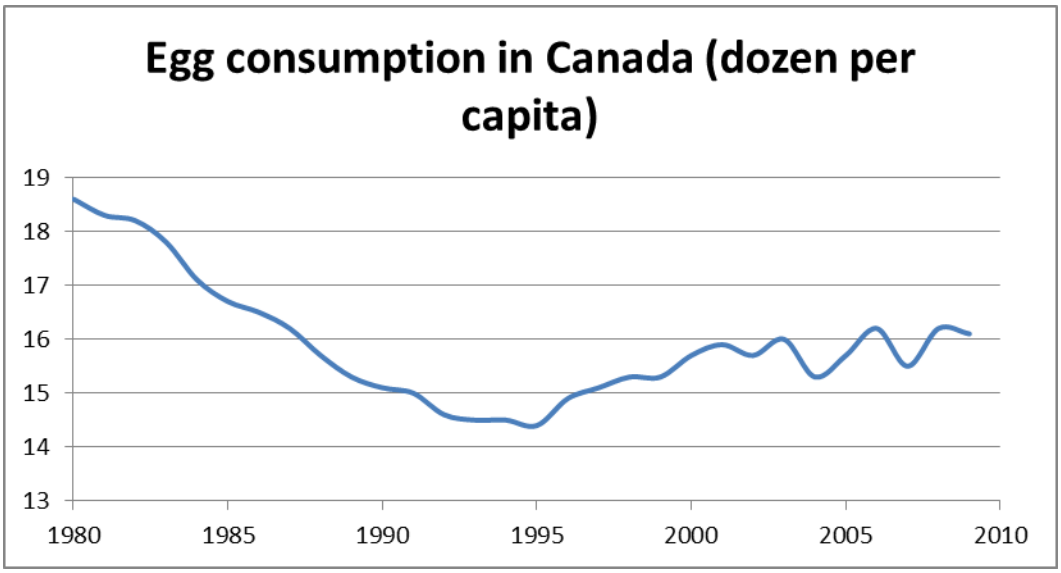

Figure 1-1. Egg consumption per capita, per annum in Canada 1980-2009 (source: Statistics Canada 2010)

The rebound could be partially attributed to two factors. First, over the past few years, with ever-increasing positive medical coverage and research findings concerning the health benefits

of eggs, eggs have been considered to be a healthy food choice by Health Canada's "*Eating Well with Canada's Food Guide*" and the Heart and Stroke Foundation of Canada's "*Health Check*™" program if consumed in moderation (Hu et al. 1999; Katz et al. 2005; EFC 2009, 2010). Second, the introduction of a variety of specialty eggs is considered to be another primary driver of increased egg demand (Sim and Sunwoo 2000; Hailu and Goddard 2004; Karipidis et al. 2005; Goddard et al. 2007).

Recent years have witnessed a rapid growth in specialty egg consumption. According to AC Nielsen retail sales data, sales of specialty eggs in Canada increased by 21.4% between 2008 and 2006, whereas sales of regular eggs in Canada increased by only 3.2% between 2008 and 2006 (BC Egg Marketing Board 2009). In addition, consumer spending for specialty eggs in Canada rose from $94 million at the end of 2005 to $120 million at the end of 2007 (AAFC 2008).

Although there is no unified definition, specialty eggs differ from regular eggs in the way hens are housed or fed, or the way eggs are processed (EFC 2009; CCFA 2009). In this regard, specialty eggs in this study refer to eggs with enhanced attributes in terms of feed (e.g. omega-3 enhanced feed and vitamin-enhanced feed), production method (e.g. free run and organic) or processing practice (e.g. pasteurized). Despite the fact that nutrient values can be altered only by changing the feed formula eaten by hens (EFC 2009, 2010) and eggs produced under alternative housing environments (e.g. free run and organic) typically have similar nutritional composition to those produced from battery cages, many consumers think otherwise (Eng 2009; Gerken 2010; HSUS 2010).

Specialty eggs satisfy consumers' demands for a wider range of tastes, health benefits, food safety and animal welfare. For example, eggs produced in alternative housing environments (e.g.

free run, free range[1] and organic) offer consumers choices as to egg production and hen welfare, since the vast majority of Canada's eggs (approximately 98 percent) come from hens kept in conventional battery cages (CCFA 2009). A series of recent consumer poll results, commissioned by animal welfare groups suggested that the majority of Canadians cared about the well-being of laying hens and around 10% of the respondents already regularly purchased cage-free eggs (including free run, free range and organic eggs) (WSPA and CCFA 2005; WSPA 2008; VHS 2009). However, due to the credence nature of quality-differentiated specialty eggs, consumers cannot easily detect or assess the quality attributes before or after purchase and consumption (Nelson 1970; Darby and Karni 1973). Consequently, verification or certification systems have been introduced to assure consumers of the quality claims displayed on food packages (Caswell 2001). It is noteworthy that most specialty eggs sold in the Canadian egg market are neither certified nor verified except for organic eggs. Some organic eggs are certified by third-parties, such as certified organic eggs with the Canadian Organic Regime (COR) label, British Columbia Society for the Prevention of Cruelty to Animals (BC SPCA) certified eggs (available in parts of Canada), and Local Food Plus (LFP) cage-free eggs based in Toronto (CCFA 2009). In addition, as pasteurized eggs are not available in the Canadian market, it is worthwhile to assess how consumers' knowledge of pasteurized eggs and risk preferences influence choice behaviors in a hypothetical context, thereby providing useful policy information for the potential market prospects for pasteurized eggs.

Despite the overall rapid market growth of specialty eggs, the market share of various types of specialty eggs remains small relative to regular eggs (Bejaei 2009). According to 2008 Nielsen

[1] The difference between free range eggs and free run eggs is that free range eggs come from hens that are either raised outdoors or have outdoor access, whereas free run eggs are produced by hens that are only raised indoors without battery cages.

data and a usage and attitude study, regular eggs occupied a 84.5% market share nationwide, followed by omega-3 eggs (12%), and the other specialty eggs compose only a 3.5% market share (EFC 2008). In order to boost consumers' demands for specialty eggs, the egg industry needs to obtain information on consumers' preferences for egg attributes, their perceptions of egg quality and consumers' purchasing behaviours (Verified Eggs Canada Inc. 2008). With such information, quota allocations to produce different egg types would need to be adjusted to reflect actual market demand, since consumers' demand for certain types of specialty eggs might be suppressed (Bejaei 2009; BC Egg Marketing Board 2010).

However, it is not easy for egg marketers and policy makers to understand egg consumers' purchasing behaviour. It is widely acknowledged that consumers' food purchasing behaviour has been shown to be jointly affected by multiple dimensional factors, such as human psychology, socio-demographic and economic characteristics (Grunert 2005; Espejel et al. 2007; Costell et al. 2009). Recent studies and survey results have shown that consumer' attitudes, perceptions, beliefs and socio-demographic characteristics affect the choice of eggs purchased, and that some consumers are willing to pay premiums for eggs with enhanced attributes (Goddard et al. 2007; Bejaei 2009; Romanowska 2009).

1.2 Problem Statement and Research Objectives

This research builds on studies undertaken by Bejaei (2009) and Romanowska (2009). In their studies, specialty eggs were differentiated only by a limited number of attributes. In this regard, it is insufficient to reveal the nature of trade-offs for individual attributes compared to the scenarios in which specialty eggs are further differentiated by a greater number of attributes. For example, organic eggs can be further differentiated by shell colour, feed and pasteurization. Additionally, in the previous egg studies, researchers estimated only the confounding effects of generic types of specialty eggs (e.g. organic eggs without further differentiation by shell colour,

feed or pasteurization) without disentangling the effects of individual egg attributes on the choice decision (Goddard et al. 2007; Bejaei 2009; Romanowska 2009). In such cases, if there are interaction effects between different types of attributes, the estimation results with regard to attribute preference might be biased. For example, Chang et al. (2010) found that egg consumers in Dallas and San Francisco tend to associate the implicit price of cage-free and organic attributes with egg shell colour, and that a significant proportion of the premium identified for such eggs over regular eggs depends on shell colour. In order to test whether egg consumers evaluate attributes together, it is important to consider the main effect of attributes, as well as two-way interaction effects between attributes.

Finally, there is little information available in the literature about how the introduction of verified specialty eggs affects consumer demand for unverified specialty eggs. This point gives rise to the question of whether the introduction of verification results in a stigma effect on unverified counterparts. Research conducted by Romanowska (2009) identified that the price premium of uncertified vitamin-enhanced eggs and pasteurized eggs identified in the revealed preference experiment became negative or zero in the stated preference experiment where "certification body" was introduced into the choice design. Nevertheless, willingness to pay (WTP) estimates from revealed preference experiments and stated preference experiments are not comparable in Romanowska's study due to the difference in the survey design.

This study uses a choice experiment where consumers of egg products were provided with a combination of five egg attributes at varying levels: price, shell colour, production method, feed, and pasteurization. The overall objective of this thesis is to identify Canadian consumers' valuation of changes in attribute levels of specialty eggs relative to regular eggs, with an

emphasis on revealing factors affecting preference heterogeneity and the consumer profile of diverse market segments. The first objective is to:

- Identify Canadian consumers' preferences and WTP for various specialty eggs and how consumer characteristics, attitudes, perceptions and other psychological factors affect valuation of egg attributes.

The primary focus is on the relative importance of egg attributes in consumers' purchasing decisions and segmentation of egg consumers based on the differences in observed characteristics and attitudes towards egg quality. In light of an increase in market sales of specialty eggs, a pertinent question is what types of egg attributes really matter to Canadian consumers and how much they are willing to pay for these value-added attributes when purchasing eggs. Specifically, this study aims to understand how enhanced egg attributes affects choice of eggs. Do consumers' risk preferences affect their stated WTP for pasteurized eggs? In addition, it is intriguing to find out the heterogeneity of behaviour between frequent purchasers of eggs and non- or seldom egg purchasers. Finally, this study also seeks to understand how consumers' knowledge towards production method and nutritional information of egg types influences their assessment and evaluation of them.

The second objective is to:

- Determine whether willingness to pay for free run eggs is significantly different when a verified free run attribute is introduced.

The purpose is to explore whether the verified free run attribute has an impact on consumers' marginal willingness to pay for egg attributes, particularly the attribute level of unverified free run.

1.3 Organization of Thesis

The thesis is organized as follows. Chapter 2 reviews the literature on consumers' preferences for agri-food products and provides a summary of recent Canadian egg research. Chapter 3

describes the theory, survey instrument and the development of the choice experiment. Chapter 4 illustrates the theoretical foundation and empirical methodology utilized in this study. Chapter 5 provides a descriptive analysis of the survey sample. Chapter 6 provides model results and discussion, followed by concluding comments and industry implications in Chapter 7.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

This chapter is divided into four sections. The first section provides a definition of credence attributes and how consumers' perceptions of food quality affect their purchasing decisions; the second section describes the role of certification schemes in alleviating information asymmetry in credence goods markets; the third section reviews the literature explaining consumer preferences for credence goods; and the final section examines recent Canadian egg research.

2.2 Consumer Perception of Food Quality

From an economics perspective, consumers' purchasing decisions are made to maximize utility derived from a good. Lancaster (1966) proposed that goods are a bundle of characteristics or attributes; therefore a consumer's demand for a product reflects the demand for that product's attributes. Since food products of higher quality are associated with higher prices, consumers have to trade off between different attributes to meet their own needs as a result of income constraints. Therefore, alternative types of eggs can be defined as a combination of attribute levels, such as price, production method and shell colour. Egg consumers have to trade off attribute level combinations when deciding to purchase different types of eggs in order to maximize their utility. However, some food quality attributes, such as food safety, animal welfare, and health are difficult for consumers to verify. Therefore, consumers might lose utility by making less-informed purchase decisions, depending on the extent to which their attitudes and perceptions towards food attributes correctly correspond to the attribute for which they are paying.

According to Darby and Karni (1973) and Nelson (1970), product attributes can be categorized as search, experience and credence attributes. Search attributes can be observed and

assessed by consumers before purchase, such as colour and size. Experience attributes cannot be assessed until consumers have used the product, such as taste and cooking performance. Credence attributes are those for which consumers cannot detect or assess before or after purchase and consumption, such as animal welfare and food safety. Due to prohibitively high search costs or difficulty assessing the presence of credence attributes, consumers often rely on quality indicators (e.g. labeling and certification) and cues (e.g. price and past purchase experience) to form expectations of food quality (Caswell 2001). Grolleau and Caswell (2005) identified that consumers perceived a connection between environmental friendliness characteristics and the levels of search and experience attributes in products with environmental soundness claims. For instance, some consumers might believe that food products with eco-labeling taste better. Fearne and Lavelle (1996) identified that the majority of free run egg consumers perceived them to taste better. Research by Romanowska (2009) also showed that free run eggs were perceived by respondents to be more natural, to have not been treated with antibiotics and to taste better. Similarly, another study showed that locally grown apples were considered by some respondents to be firm, free of pests and diseases and have good flavour (Dentoni et al. 2009).

Furthermore, even though consumers might be well aware of perception bias, it is still difficult for consumers to calibrate their perceptions of credence attributes over time after purchase or with new information sources (Caswell et al. 2002; Grunert 2005; Espejel et al. 2007). Consequently, there is a need to incorporate consumer perceptions of egg quality into an empirical analysis of preferences for credence attributes in eggs.

2.3 Certification Schemes and Information Asymmetry

Certification or verification, have the potential to mitigate the severe information asymmetry problem and facilitate consumers to make choices that are aligned with their expectation of

quality of credence goods. Through certification or verification, credence attributes can be transformed into search attributes, which would facilitate the process of quality evaluation and communication between buyers and sellers (Caswell 2001; Umberger et al. 2003).

A large body of literature suggests that some consumer segments are willing to pay premiums for the certification of product quality claims, such as improved safety (e.g. rBST-free and growth hormone-free), enrichment of nutrition (e.g. vitamin and omega-3 enhanced) and certain types of production or processing practices (e.g. organic and animal welfare) (Umberger et al. 2003; Bernard and Mathios 2005; Bonti-Ankomah and Yiridoe 2006; Aguilar and Vlosky 2007). However, caution should be exercised that providing consumers with information regarding credence attributes without considering consumers' capabilities and heterogeneity in information processing and perceptions of information sources might be insufficient to mitigate information asymmetry (Caswell 1998; Grolleau and Caswell 2005; Gellynck et al. 2006).

There are very few Canadian egg studies that investigate the impact of certification on consumers' evaluation of credence attributes. Romanowska (2009) found that there is no premium or negative premium for uncertified specialty eggs when certified specialty eggs are available, which might be due to the small sample bias or externality effect arising from the availability of certified specialty eggs. For instance, respondents were indifferent between regular eggs and uncertified free run eggs in terms of WTP when certified free run eggs were available in the stated preference study. Currently, specialty eggs (except for organic eggs) are voluntarily verified or certified by public or private certifying bodies (e.g. BC SPCA, LFP and Verified Eggs Canada Inc.). To date, there is little research that tests for the effect of the certification of specialty eggs on consumers' WTP for uncertified counterparts. In

Romanowska's study, she estimated only the consumers' WTP for certification of credence attributes without testing the possible externality effect of certified specialty eggs.

2.4 Factors Affecting Consumer Preferences for Credence Goods

It is well-known that there is significant heterogeneity in consumers' preferences for food quality. Therefore, it is necessary to investigate how factors such as attitude and knowledge towards credence attributes, past purchase experience and socio-demographic profiles affect consumer demand for credence goods.

Socio-demographic and Economic Factors

There are no consistent findings about the impact of socio-demographic and economic factors on consumers' preferences across credence goods. Gender, number of children, family size, educational level, income, price and age are among the relatively important and significant factors that influence consumers' preferences and WTP for credence goods; however, the direction and magnitude of correlation and resulting WTP can vary across types of credence goods (Thompson 1998; Wessells et al. 1999; Huang et al. 1999; Heiman et al. 2000; Armah and Kennedy 2000; Boccaletti and Nardellab 2000; Loureiro and McCluskey 2000; James and Burton 2003; Li et al. 2003; Hatirli et al. 2004; Aguilar and Vlosky 2007; Angulo and Gil 2007; Romanowska 2009; Probst et al. 2010).

For instance, some studies reported that older respondents and respondents with large families were generally less likely to purchase specialty eggs because of income constraints (Goddard et al. 2007); respondents with higher levels of income were found to consume fewer white regular eggs and more free run and organic eggs (Goddard et al. 2007; Bejaei 2009); older people are less likely to prefer certified eggs (Romanowska 2009). It has also been demonstrated that price was deemed to be the most important factor for the choice of white regular eggs, and that consumers' sensitivity to price was different and affected by several factors, including the

number of minors at home and the age of household heads (Fearne and Lavelle 1996; Goddard et al. 2007; Bejaei 2009).

Some studies reported that socio-demographic characteristics such as marital status, membership in environmental organizations, religion and community (living in urban areas versus rural areas) might also help in explaining consumer choices for credence goods (Thompson 1998; Wessells et al. 1999; Armah and Kennedy 2000; Heiman et al. 2000; Botonaki et al. 2006). Additionally, many studies found that attitude, perception, knowledge towards credence goods, past purchase experience or habits, and health consciousness and behaviour are more significant in interpreting preference heterogeneity than socio-demographic factors (Verbeke 2005).

Attitudes towards Food Quality

Attitudes towards credence attributes have been identified to be major driving forces behind the decision to purchase food products, which vary among consumers and types of food products. Moon and Balasubramanian (2003) stated that consumers' acceptance and preference for agri-foods produced using agro-biotechnology was affected by their perceptions of risk associated with bio-foods and environmental perceptions of agro-biotechnology. Further to that, consumers who were more risk averse were more likely to perceive non-GM foods as quality-improving (Baker and Burnham 2001).

Some credence attributes can act as proxy signals for a range of perceived qualities. For example, Brennan et al. (2003) reported that consumers perceived organic meat as healthier, more nutritious and tasting better than non-organic counterparts, despite potential health risks of Escherichia coli and salmonella associated with organic meat. Animal welfare concerns are also motives for consumers' decisions to purchase organic foods (Harper and Makatouni 2002; Goddard et al. 2007). Analogously, some consumers perceived animal welfare as a cue for food

safety and sensory attributes (Phan-Huy and Fawaz 2003). In the context of egg products, Bejaei (2009) found that free range, free run and organic eggs were chosen by some respondents who perceived them to be indicative of better animal welfare, healthfulness and taste.

Fearne and Lavelle (1996) found that egg consumers in the UK were concerned about cholesterol levels as well as bird welfare, and that free range egg consumers perceived free range eggs from happier laying hens to taste better. Most consumers agreed that battery-egg production was cruel, but some would purchase regular eggs in spite of this knowledge. The blind taste test between different types of eggs (battery eggs, free range eggs and branded eggs) showed that there was no significant difference in terms of perception of taste compared to the informed version in which respondents were informed about which type of eggs they tasted.

Baltzer (2004) found that Danish egg consumers concerned about animal welfare and organic production were willing to pay extra for enhanced animal welfare and organic housing practices. Goddard et al. (2007) recognized that a series of attitudinal factors significantly affected consumers' willingness to pay for specialty eggs. One intriguing finding in their research was that consumers' perceptions of organic and free run eggs were associated with health benefits, even though there is no nutritional difference between those eggs and regular eggs.

In addition, consumers' health consciousness, behaviours and their family members' health conditions were also found to be related to the choice of certain types of credence goods, particularly for functional foods. For example, when a family member was ill, respondents were more likely to choose nutrient fortification or pesticide free products, such as functional foods and hydroponically grown vegetables (Huang et al. 1999; Verbeke 2005). Goddard et al. (2007) found that health-conscious consumers preferred specialty eggs and were willing to pay premiums for them, which is consistent with results identified in Asselin (2005) who found that

respondents' health behaviour and consciousness were significantly correlated to WTP for omega-3 enhanced eggs, and that respondents who were more health conscious were more likely to buy omega-3 enhanced eggs.

Previous egg researchers also suggested that shell colour matters in consumers' choices of eggs (Goddard et al. 2007; Bejaei 2009; Romanowska 2009), although the impact of shell colour was not separately analyzed from credence attributes. Chang et al. (2010) identified a substantial proportion of the price premium of cage-free and organic egg consumers depended on whether those eggs had brown shells in Dallas and San Francisco.

Purchasing Behavior and Knowledge

Respondents' past purchasing behaviours, such as consumption levels and purchase frequencies can significantly influence the choice of certain types of credence goods and WTP due to the persistent impact of habit formation and reluctance to change (Campiche et al. 2004; Botonaki et al. 2006; Angulo and Gil 2007). Thompson (1998) maintained that awareness of where consumers purchased foods might be of great importance in tapping into organic foods markets. Analogous to his assertion, Ubilava and Foster (2009) also suggested that factors such as location and type of outlet might be linked to food attributes, providing producers with additional marketing strategies. Respondents' egg purchasing habits might, to a certain extent, affect their knowledge and perception of egg quality. For example, the AC Nielsen Homescan data indicated that Albertan households with higher grocery store expenditures purchased more specialty eggs (Goddard et al. 2007).

Several researchers identified that lack of knowledge about production methods, and the lack of product availability are also barriers to purchasing credence goods with enhanced attributes (Wessells et al. 1999; Harper and Henson 2001; Kozak et al. 2004; Botonaki et al. 2006; Bonti-Ankomah and Yiridoe 2006). Fearne and Lavelle (1996) found that consumers were not well

aware of the various egg production methods. Ambiguity and the lack of knowledge regarding product quality and quality assurance systems were also found to affect respondents' WTP for credence goods (Baker and Burnham 2001; Brennan et al. 2003; Li et al. 2003; Schroder and McEachern 2004; Verbeke 2005). Romanowska (2009) found that respondents were misinformed about certification regimes and institutions responsible for quality assurance claims and standards; on average, respondents were aware of approximately half of the certification process for nutritional claims: for example, industry is responsible for claims about being vitamin-enhanced.

In summary, a wide range of factors can affect consumers' egg purchases. In a consumer-driven market, it is important for egg producers and marketers to understand these factors to improve their product development plans and marketing strategies. However, there is a lack of research that investigates the interaction effects among such factors.

2.5 Summary of Recent Canadian Egg Research

Cranfield and Henson (2009) conducted an online survey by randomly selecting 2,000 residents from a Guelph Food Panel in 2008 to assess respondents' response to egg products with animal welfare quality, including free run and free range eggs. They found that choices to buy both types of eggs were correlated with attitude towards conventional housing methods for hens and awareness of animal welfare.

Based on analyses of stated preferences in Alberta, and revealed preferences in Alberta and Ontario, Goddard et al. (2007) reported that most consumers were not willing to pay more for specialty eggs than for regular eggs. Furthermore, a series of attitudinal and socio-demographic factors were identified to be closely associated with preferences for egg attributes, such as health and animal welfare concerns. For instance, families with children and older shoppers tended to be more responsive to price changes.

Bejaei (2009) conducted an online survey in June 2009 to elicit consumers' actual purchasing behaviours and corresponding profiles of different types of egg consumers from 702 adult BC residents. Her research also revealed the importance of factors including consumers' characteristics and attitudes in their selection of alternative types of eggs. For example, results in her survey questionnaires indicated that consumers with higher education and income levels actually purchased more free-range eggs compared with regular eggs. Further to that, results also suggested that the importance of factors varies considerably across consumers of different types of eggs. For instance, in terms of consumers' reasons for preference of a particular type of egg, regular eggs were mostly chosen by regular egg purchasers because lower price was rated to be an important factor, whereas nutrient-enhanced eggs were mainly chosen due to the perceived nutritional value and health benefits by respondents. Nevertheless, her study did not involve the empirical analysis of choice models and WTP information and the survey results were applicable to only BC consumers.

Another recent Canadian egg study undertaken by Romanowska (2009) focused on the impact of certification on consumer preferences for credence attributes in eggs. She adopted two information treatments (choice task prior to a survey vs. choice task after a survey with and without a real experiment prior to the stated preference exercise). She found a significant variation in consumers' willingness to pay for certification; consumers generally prefer certified specialty eggs to uncertified counterparts and government to be the most preferred certifying body regardless of egg types. Consumers' overall trust levels, shopping location, age and income also affected consumers' choice of egg types and related certifying bodies. For example, consumers who usually bought eggs at the farmers' market were more price sensitive, richer people would pay more for free run eggs, and consumers with high general levels of trust had a

preference for farmer certification of vitamin-enhanced and free run eggs. In her study, three segments of egg consumers were classified, including “the rational trade-off consumer”, “the price-conscious consumer” and “the free-run lover”. Romanowska’s research revealed a negative premium for uncertified specialty eggs versus regular eggs, which is inconsistent with the actual specialty egg markets where specialty eggs are priced higher than regular eggs. Additionally, the results might be due to a small sample size bias and limited egg attributes. Finally, the results were generalized only to Edmonton consumers.

The literature shows that it is necessary to cover a broader range of egg attributes in consumers’ preferences for specialty eggs. It is commonly acknowledged that the importance and value of egg qualities considerably differ among egg consumers. This study aims to examine egg consumers’ preference heterogeneity and profile of consumer segments at a national level relative to the regional level covered in previous egg studies.

2.6 Conclusion

A summary of recent egg studies indicates that consumer motivation is complex regarding egg purchasing behaviour. Based on previous bodies of research, it is important to evaluate consumers’ socio-demographic characteristics and attitudes towards egg quality to understand egg consumers’ preferences. This study will add to existing egg research by examining the potential correlation of egg attributes rather than treating egg attributes independently. This is important because results will be useful to eggs producers and marketers who will better understand consumers’ demands and can change production methods or outputs to better satisfy customers.

CHAPTER 3
THEORY AND SURVEY DESIGN

3.1 Introduction

This chapter focuses on the research approach rationale and the development and organization of the choice experiment (CE) survey. This chapter discusses Lancastrian consumer theory, and the CE approach, which compared to other attribute-based methodologies, is more suited to this research. This chapter also elaborates on the survey design, which includes the survey instrument, composition and administration, and a brief review of a wide array of survey questions regarding egg-shopping habits, attitudes toward food safety and health, perceptions of egg quality and socio-demographic characteristics.

3.2 Demand and the Choice Experiment Approach

Traditional demand theory posits that individuals choose goods in order to maximize utility. In this context, the attributes considered in the utility function are quantity and price. However, significant variation in qualities or attributes of products is important when evaluating products. Therefore, separate assessment of individual product attributes is masked under the overall evaluation of price by the means of a demand function.

Unlike traditional demand theory, Lancaster (1966) developed an attribute-based demand theory which assumes that consumers derive utility from characteristics or attributes of a product rather than from the product per se. Lancaster's approach aims to maximize the aggregate of individuals' utilities arising from a given bundle of attributes of a good. This approach is conducive to understanding the overall utility consumers obtain from egg consumption based on egg attributes: price, shell colour, production method, feed and pasteurization.

Founded in consumer theory, a multitude of methods have been developed to gauge individuals' preference for goods, which can be categorized as revealed preference (RP) or stated

preference (SP) methods (Louviere et al. 2000; Train 2003). As the name indicates, RP relies on observations of real market behaviour to elicit individuals' preferences. Therefore, RP explanatory variables might suffer from little variability and be highly collinear (Hanley et al. 1998; Louviere et al. 2000; Hensher et al. 2005). In this regard, it is difficult or impossible for researchers to estimate the individual impact of variability of an attribute. Furthermore, RP data are not available for new products. In contrast to RP, SP relies on participants to state their preferences in a hypothetical setting. Thus, SP is more appropriate in this research for two reasons. First, because market-level data on sales of pasteurized eggs and other hypothetical egg profiles do not exist in Canada, stated preference data are thus needed to evaluate the relative importance of attributes in consumers' purchasing behaviours. Second, through SP survey design, researchers have better control over the data to satisfy model assumptions and permit rigorous testing of relevant research hypotheses.

Among a set of stated preference methods, the CE approach has frequently been used by economists and market researchers over the past two decades (Hanley et al. 1998; Train 1998; Revelt and Train 1998; Adamowicz et al. 1998; Hensher 2001; Boxall and Adamowicz 2002; Carlsson et al. 2003; Lusk and Schroeder 2004; Lagerkvist et al. 2006; Mtimet and Albisu 2006; Loureiro and Umberger 2007; Tonsor et al. 2009; Olynk et al. 2010; Innes and Hobbs 2011; Uzea et al. 2011). In a typical CE task, respondents are asked to make repeated choices among hypothetically constructed alternatives described by a defined set of attributes. Hence, the total utility consumers derive from choosing a product is the sum of the individual utilities gained from the attributes of that product. With this methodology, researchers are able to examine consumers' trade-offs among attributes and to compute WTP for such attributes (Boxall et al. 1996; Hanley et al. 1998).

While there are many benefits to using the CE approach, choice experiments are prone to hypothetical bias (Carlsson and Martinsson 2001; Lusk 2003; Lusk and Schroeder 2004) where respondents overstate their WTP. To reduce hypothetical bias, "certainty questions" were used in this study (Champ and Bishop 2001). For example, after each choice task, respondents were asked to rate how certain they were about their decision, ranging from 1 (no confidence at all) to 10 (complete confidence).

3.3 The Survey Design

The first stage of the design involved identification of attributes with varying levels including: price, shell colour, production method, feed and pasteurization. The five attributes were chosen on the basis of previous egg studies that indicated their importance of such attributes in consumers' egg purchasing decisions (Goddard et al. 2007; Romanowska 2009; Bejaei 2009). To assess consumers' marginal WTP for unverified free run eggs, two CE treatments were designed in which all the attributes and correspondent levels are identical except for production method. Version 1 included: conventional battery cages, free run and organic; version 2 included a fourth level: verified free run. The remaining attributes and levels were identical between versions. Each respondent answered one version of the survey. Table 3-1 illustrates egg attributes and levels used.

Table 3-1. Egg attributes and levels

	Version 1	Version 2
Attributes	Levels	
Shell colour	*White* Brown	*White* Brown
Production method	*Conventional battery cages* Free run Organic	*Conventional battery cages* Free run **Verified free run** Organic
Feed	*Regular feed* Omega-3 enhanced feed Vitamin-enhanced feed	*Regular feed* Omega-3 enhanced feed Vitamin-enhanced feed
Pasteurization	Pasteurized to kill Salmonella *Not Pasteurized*	Pasteurized to kill Salmonella *Not Pasteurized*
Price(per dozen)	*$2.15*, $3.43, $4.71 or $5.99	*$2.15*, $3.43, $4.71 or $5.99

Note: The attribute levels of regular eggs (constant option C) are italicized; the extra attribute level in version 2 is represented in bold.

The motivation for the information treatment arose from Romanowska (2009). In her study, when free run eggs were further differentiated by certification organization, the price premium was not statistically different from zero compared to regular eggs, whereas people were willing to pay a premium for certified free run eggs regardless of certifying organization. This is not consistent with the results from her revealed preference choice experiment and the real market where people are willing to pay a premium for uncertified free run eggs. Romanowska (2009) suggested this finding might result from the unique characteristics of the surveyed respondents who did not prefer uncertified free run eggs. Nevertheless, respondents' marginal WTP for uncertified eggs might be negatively affected by the existence of certified counterparts.

Respondents were asked to make a choice between three alternative types of eggs or none. As a basis of comparison, the third egg product (option C) was regular eggs where all attributes were fixed at the base level (see Table 3-1) in each choice set. The fourth alternative (option D) is an opt-out option. Since option C and option D are constant in each choice situation, the

experimental design is used to generate egg profiles for the first two alternatives by manipulating attributes and their levels and pairing of them. Given the five attributes and their associated levels, a large number of different egg alternatives could be constructed if using the full factorial design[2]. In order to reduce the number of the choice tasks respondents face while maximizing the statistical performance of coefficient estimates, this study employed the fractional factorial design (Louviere et al. 2000; Carlsson and Martinsson 2001).

Because two versions of CE questions were answered by two groups of respondents, this study sought to create a different experimental design for each version. The difference between the two designs is that the production method is varied at four levels in the version 2. To accommodate the objectives, a D-optimal design was used to maximize the determinant of the information matrix (see Kuhfeld 2010 for detail). Based on a computer-generated search algorithm in the D-optimal design. The final design consisted of 32 choice sets for each CE treatment (Louviere et al. 2000; Kuhfeld 2010). In order to minimize respondents' cognitive burden, it was decided to present each respondent with only four choice sets. Hence, for each CE treatment, the resulting 32 choice sets were further grouped into 8 blocks, each with four choice sets. In this regard, eight blocks fell into version one; the other eight blocks were retained for version two. Each respondent was randomly allocated to one block in which they were asked to complete four randomized choice sets to mitigate an ordering effect so that previous CE questions would not affect consumers' responses to subsequent responses in a systematic way.

Prior to the choice experiment, an information sheet was presented to respondents that included detailed descriptions of egg attributes, levels, the nutritional value of a Canadian Grade A large egg as well as nutrition comparisons between regular and specialty eggs. The product

[2] Full factorial design refers to a design that contains all possible combinations of the levels of the attributes.

was a one-dozen carton of Canadian Grade A eggs. Respondents who were randomly assigned to each version were shown the corresponding information sheet and choice task. Readers can refer to the information sheet for clarification of egg attributes and levels provided in the Appendix (Section I).

In each choice set, respondents were asked to choose their preferred carton of eggs as if they were making an actual egg purchase during a typical shopping trip. The addition of an opt-out alternative (option D) allowed respondents to choose not to purchase any of the three types of eggs, which was intended to provide a realistic market setting. The first two alternatives of each choice set included specialty eggs characterized by a combination of egg attributes that varied in shell colour, production, feed, pasteurization or price. The third alternative was regular eggs (white, conventional battery cages, regular feed, not pasteurized at a price of $2.15). Table 3-2 and Table 3-3 provide one example of a choice set from versions 1 and 2 of the survey design.

Table 3-1. An example choice question (Version 1)

	Option A	Option B	Option C	Option D
Shell colour	White	Brown	White	
Production method	Free run	Conventional Battery cage	Conventional Battery cage	
Feed	Regular feed	Omega-3 enhanced feed	Regular feed	I wouldn't buy any
Pasteurization	Not Pasteurized	Pasteurized	Not Pasteurized	
Price	$3.43	$2.15	$2.15	
I choose	☐ Option A	☐ Option B	☐ Option C	☐ Option D

Table 3-2. An example choice question (Version 2)

	Option A	Option B	Option C	Option D
Shell colour	White	Brown	White	
Production method	Organic	Verified free run	Conventional Battery cage	
Feed	Regular feed	Omega-3 enhanced feed	Regular feed	I wouldn't buy any
Pasteurization	Not Pasteurized	Pasteurized	Not Pasteurized	
Price	$3.43	$5.99	$2.15	
I choose	☐ Option A	☐ Option B	☐ Option C	☐ Option D

Lastly, in order to better account for and interpret the motivation behind respondents' choice decisions, six questions asked how respondents made their decision using a five-point Likert scale (Question 5, Section I).

3.4 Survey Questions about Respondents' Characteristics

After completing choice tasks, respondents were asked to answer a series of questions related to purchasing habits, attitudes, risk preferences and socio-demographics. Questions were posed using a five-point Likert scale. Section II of the Appendix provides a full explanation of all questions.

Respondents were required to answer six questions with respect to egg purchasing frequency, location, egg type preferences, packaging sizes and prices. It is speculated that respondents who consume eggs frequently might value certain egg attributes differently from those who do not. By examining egg purchasers' behavior and their shopping habits, factors that affect egg consumers' purchasing decisions would be revealed, thereby facilitating egg producers and marketers to adjust their egg production offerings, pricing strategy and package design to better accommodate egg consumers' preference in actual shopping settings.

Respondents were also asked about their general perceptions of food safety, their confidence in the safety of product categories, perceptions about the responsibility of actors in the food chain for food safety, reactions to a hypothetical food safety scandal regarding egg production in Canada, and consumers' risk and health attitudes. De Jonge et al. (2007) argued that general confidence in the food safety comprises two separate dimensions: optimism and pessimism where both optimism and pessimism can coexist among consumers. In order to gain information on respondents' general perception of food safety, three questions were adopted from the literature (De Jonge et al. 2007; De Jonge et al. 2008).

Another set of survey questions dealt with consumers' risk preferences, perceptions of risk with respect to eating eggs, health behaviours and attitudes. Weber et al. (2002) pointed out that respondents' risk preference was not homogenous but that it varies across all content domains, such as financial, health/safety, recreational, ethical and social decisions. In other words,

people's risk preference is domain-specific instead of constant. Therefore, it is possible that consumers' risk preferences in the domain of health/safety and recreation decisions might affect their preference for different types of eggs, especially pasteurized eggs that embody safety attributes. To elicit risk preferences, two separate sets of risk attitude scales in the domain of health/safety and recreation were extracted from Weber et al. (2002).

One survey question concerning the presence of family members with an illness was included. In addition, respondents were also asked to indicate the extent to which they agreed with nine statements relating to health behaviours and attitudes on a 5-point Likert scale. The first three of nine statements were related to respondents' health practices; the second three were about health awareness and perception; the last three statements (extracted from scales developed by Wallston et al. 1978) were used to measure respondents' attitudes towards a health locus of control. In this research, it is expected that there might exist a correlation between consumers' health attitudes and their inclination and willingness to pay for health attributes of specialty eggs, such as omega-3 enhanced eggs and vitamin-enhanced eggs.

Egg knowledge questions arose from consumers' unfamiliarity with types of eggs in terms of production method and nutrition information in previous egg studies (Fearne and Lavelle 1996; Goddard et al. 2007; Bejaei 2009). Respondents were required to rate their knowledge of the production method and nutritional information of several types of eggs. It is expected that respondents' WTP for different types of eggs might be correlated with their reported knowledge of egg products.

In addition, consumers' self-reported involvement in food-related activities can act as a proxy to assess if consumers think their actions will make a difference to food safety and quality issues

(Poppe and Kjaernes 2003). Another question assessed respondents' knowledge about the 2010 egg recall in the US, given that consumer recalls might influence egg-purchasing decisions.

To better meet egg consumers' demands for specialty eggs, it is important to understand the potential barriers to purchasing specialty eggs. Thus, two hypothetical questions were constructed to investigate the likelihood of respondents purchasing specialty eggs if they become more prevalent in their usual shopping locations or when third-party certification or verification were introduced. Some consumers might not purchase specialty eggs due to the lack of egg availability or scepticism towards authenticity of credence attribute quality claims without the introduction of third-party verification or certification.

The last section of the survey elicited respondents' socio-demographic information, including gender, age, household composition, marital status, community, income, education level and employment status. Socio-demographic information can be used to compare the representativeness of sample respondents to the Canadian population, allowing researchers to generalize the results to the whole population. Additionally, socio-demographic information might contribute to the explanation of preference heterogeneity among egg consumers through interaction terms with egg attributes or market segmentation.

3.5 Survey Instrument, Composition and Administration

An online survey was used, given comparatively low costs, faster response collection and convenience for respondents (Bejaei 2009; Gao and Schroeder 2009; Olsen 2009). Furthermore, online methods have been shown to produce WTP estimates not statistically different from other collection methods (Olsen 2009). The survey consisted of two main sections. In the first section, respondents were asked to make repeated choices among alternative types of eggs or none at all. Each egg profile was described by five attributes. Following the choice section, survey respondents were asked about socio-economic and demographic characteristics.

The survey instrument was reviewed by relevant academic researchers and pre-tested to ensure clarity and accessibility. The final survey was administered online to participants recruited from a large opt-in consumer panel by Insightrix Research. The survey was conducted in April 2011 in all Canadian provinces except Quebec (since this survey was only conducted in English). Consumers who agreed to participate in this survey were given a unique link that provided access to the web-based survey. Each respondent was allowed to complete the survey only once to avoid multiple entries. Eligible respondents were at least 18 years of age and had personally purchased eggs for their household in the past six months.

CHAPTER 4
EMPIRICAL METHODOLOGY

4.1 Introduction

This chapter focuses on the specification of discrete choice models and related hypothesis tests with regard to the research questions. It first discusses the choice modelling framework followed by alternative model specifications based on different preference assumptions and hypothesis testing, including the multinomial logit (MNL) model and mixed logit (ML) model. The analysis of these models addresses the research questions laid out in the Chapter 1. Empirical results are presented in Chapter 6.

4.2 Choice Modelling Framework

Random utility theory (RUT) underlies the consumers' choice decision and judgement. Consequently, the choice behaviour can be modelled using a random utility model framework. As shown by Adamowicz et al. (1998) and Train (2003), U_{nit} represents the utility an *n*th individual obtains from *i*th alternative within a choice task *t*. Based on RUT, the overall utility U_{nit} is assumed to consists of two components: the observable systematic portion V_{nit} (also called an indirect utility function) and the unobservable random (stochastic) element ε_{nit}. Therefore, the individual's true utility remains unknown to the researcher: the choice behaviour can only be predicted in a probabilistic manner. Furthermore, RUT postulates that an individual *n* acts rationally and chooses the alternative *i* that yields the highest utility subject to the choice set given. Thus, the probability that an individual *n* chooses the alternative *i* is the probability that the utility provided by that alternative is the highest among all possible options from a choice task *t*, which is given by:

$$P_{nit|C_t} = \Pr(U_{nit} > U_{njt}) = \Pr(V_{nit} + \varepsilon_{nit} > V_{njt} + \varepsilon_{njt}; \forall j \neq i,\ j \in C_t) \tag{4.1}$$

In this application, in each CE question, respondents were asked to choose among three alternative types of eggs or no eggs. V_{nit} is determined by the egg attributes for the *i*th alternative. C_t refers to a choice task *t* that contains four possible options (C_t =*Option A, Option B, Option C, Option D*). In the choice experiment, each respondent made four repeated choices, that is *t=4*. Consequently, panel data are modelled in this study (Train 2003; Greene 2003).

Assuming V_{nit} is linear in parameters, the generic functional form of the systematic portion of the utility function for an individual *n* choosing the alternative *i* can be expressed as:

$$V_{nit} = \alpha_0 * asc\_n + \alpha_r * asc\_reg + \beta' x_{nit} \quad (4.2)$$

Where *asc_n* and *asc_reg* are both alternative-specific constants; α_0 and α_r refer to correspondent alternative specific intercepts that capture an n^{th} individual's intrinsic preference for the alternative *i*. x_{nit} is a vector of exogenous variables associated with egg attributes and respondents' characteristics; β' refers to a vector of parameters that represent the effect of observed variables on an individual's utility. Note that the specific functional form described by Equation (4.2) might vary by model, depending on preference assumptions and research hypotheses. Table 4-1 shows the definition and coding of the main variables used in the discrete choice models.

Table 4-1. Interpretation and coding of main variables used in the choice models

Variables	Abbreviation	Description
Asc_none	Asc_n	=1 if the no purchase alternative is chosen, otherwise 0.
Asc_regular	Asc_reg	=1 if the regular egg alternative is chosen, otherwise 0.
Price	Price	The price of a one-dozen carton of Canadian Grade A large eggs, ($2.15, $3.43, $4.71 and $5.99).
Brown	Brown	=1 if brown shell colour, 0 if white shell colour.
Free run	Fr	=1 if the egg product comes from hens that are able to move about the floor of the barn, 0 if the egg product is battery caged.
Organic	Org	=1 if the egg product is raised by certified organic production methods, 0 if the egg product is battery caged.
Verified free run	Vfr	=1 if the egg product comes from hens that are able to move about the floor of the barn and a third party auditor verifies the free run process, 0 if the egg product is battery caged.
Omega-3 enhanced	Omg-3	=1 if the egg product comes from hens that are fed with a diet enriched with omega-3 polyunsaturated fatty acids, 0 if the egg product comes from hens that are fed with regular feed.
Vitamin-enhanced	Vitam	=1 if the egg product comes from hens that are fed with a diet enriched with vitamin nutrients, 0 if the egg product comes from hens that are fed with regular feed.
Pasteurized	Pasteu	=1 if the egg product is in-shell pasteurized, 0 if not.

As shown in Table 4-1, *asc_n* equals 1 if respondents choose option D (the non-purchase option), 0 otherwise; similarly, *asc_reg* takes on a value of 1 if respondents choose the constant option C (white regular eggs), 0 otherwise. Each choice set contains four generic options with only two dummy-coded alternative-specific constants, leaving the choice of either option A or B as reference alternatives relative to the two alternative-specific constants. Table 4-1 also demonstrates how five attributes with varying levels are coded in the choice modelling. For each attribute variable (except for *price*) with *n* levels, *n*-1 dummy coded variables are created relative to the n^{th} omitted variable. For example, with regards to the production method attribute, product method has three attribute levels in version 1 and four attribute levels in version 2. Thus, the

production method attribute is specified by two dummy variables for the version 1 model: *fr* (free run) and *org* (organic), whereas it is represented by three dummy variables for version 2 model: *fr* (free run), *org* (organic) and *vfr* (verified free run). The production method dummy variables take on a value of 1 if the type of eggs is produced under corresponding production practice, 0 otherwise, with conventional battery cages being the base level. *Price* is a continuous variable that reflects the impact of price change on consumers' utility and resulting probability of buying egg products. Its parameter estimate is expected to be negative.

The derivation of different discrete choice models depends on the different assumptions made about the distribution of the random term. In the following subsections, several alternative choice models that make different assumptions about the form of Equation (4.2) or the distribution of ε_{nit} in Equation (4.1) are discussed.

4.3 Alternative Model Specifications

Various choice models that allow for the assumptions underlying consumers' preferences are used to address different research questions proposed in Chapter 1. The model estimation begins with a simple multinomial logit model that assumes consumers are homogeneous in terms of taste with no interaction effects among attributes. Then, two-way interaction terms between attributes are incorporated into the base MNL model to account for the potential correlation between different types of egg attributes. Lastly, the assumption of preference homogeneity is relaxed to allow the taste parameters to vary among the sample though the application of two alternative choice models. These two models make up the extended MNL model and the ML model (also called the Random Parameter Model by some researchers). Figure 4-1 represents how the models relate to one another and the research questions each model addresses.

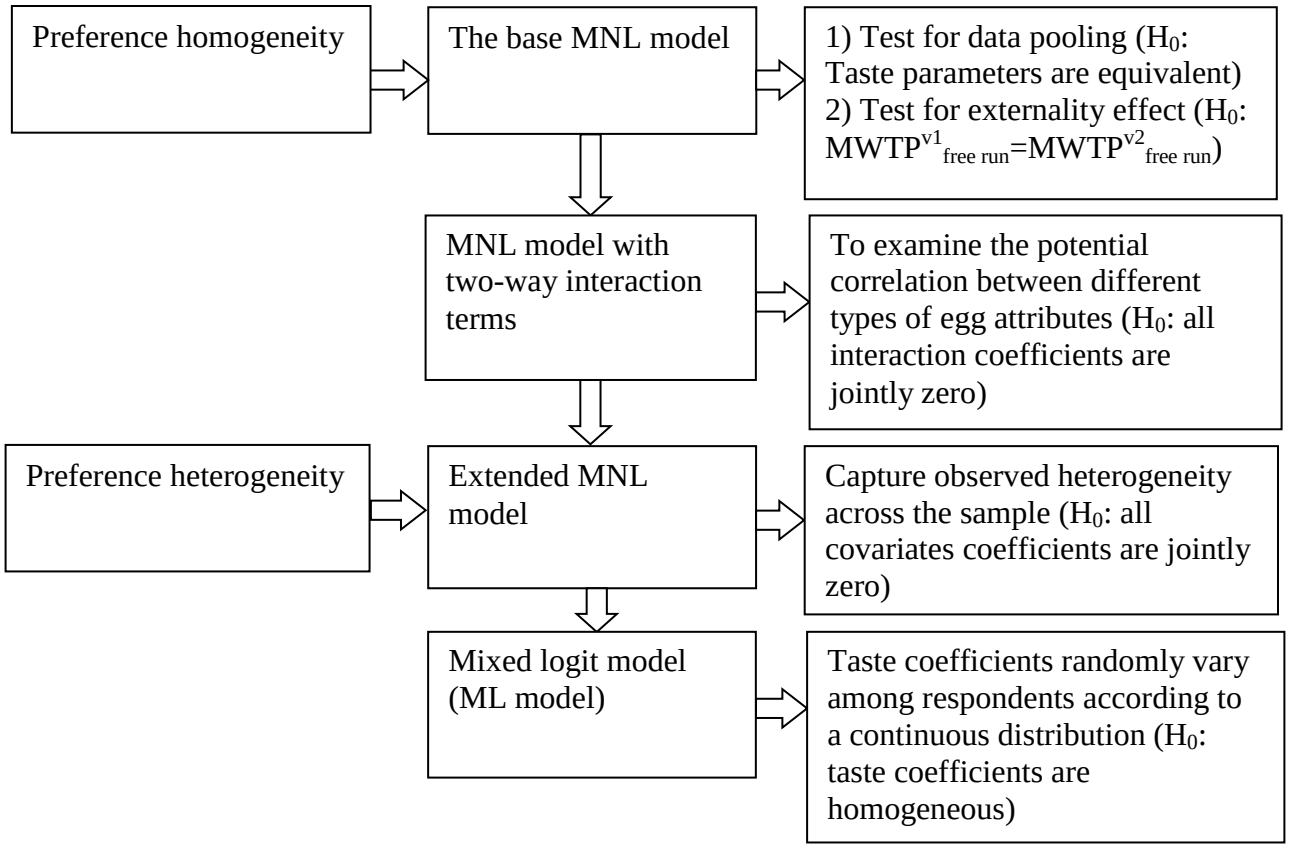

Figure 4-1. Flowchart of alternative discrete choice models

Multinomial Logit Model

The multinomial logit model is widely regarded as the appropriate starting point for discrete choice analysis. If the error term is independently and identically distributed (IID) across individuals, and alternatives and choice sets have the type I extreme value distribution, the resulting probability of an individual *n* choosing alternative *i* from the choice set *t* can be expressed by multinomial logit model as (McFadden 1974; Louviere et al. 2000):

$$P_{nit} = \frac{\exp(\mu V_{nit})}{\sum_{i \in C_t} \exp(\mu V_{nit})} = \frac{\exp \mu\left(\alpha_0 * asc\_n + \alpha_r * asc\_reg + \beta' x_{nit}\right)}{\sum_{i \in C_t} \exp \mu\left(\alpha_0 * asc\_n + \alpha_r * asc\_reg + \beta' x_{nit}\right)} \qquad (4.3)$$

where all the variables are defined as before (see Table 4-1). μ is a scale parameter and inversely related to the variance of the error term. For the MNL model, the scale parameter is typically assumed to be one, as it is unidentifiable within any given data set. However, one can estimate a relative scale parameter across data sets (Hensher and Bradley 1993; Swait and Louviere 1993; Adamowiciz et al. 1994; Adamowiciz et al. 1997; Hensher et al. 1999).

4.3.1.1 Hypothesis testing

One information treatment was conducted, resulting in two versions of data sets. Therefore, the indirect utility function that includes only the main effect variables in the MNL model for two versions is specified respectively as:

$$V_{nit}^{v1} = \mu_{v1}(\alpha_0 * asc\_n_{nit} + \alpha_r * asc\_reg_{nit} + \beta_1 price_{nit} + \beta_2 brown_{nit} + \beta_3 fr_{nit} + \beta_4 org_{nit} + \beta_5 omg_{nit} + \beta_6 vitam_{nit} + \beta_7 pasteu_{nit}) \quad \text{Version1 (4.4)}$$

$$V_{nit}^{v2} = \mu_{v2}(\alpha_0 * asc\_n_{nit} + \alpha_r * asc\_reg_{nit} + \beta_1 price_{nit} + \beta_2 brown_{nit} + \beta_3 fr_{nit} + \beta_4 vfr_{nit} + \beta_5 org_{nit} + \beta_6 omg_{nit} + \beta_7 vitam_{nit} + \beta_8 pasteu_{nit}) \quad \text{Version2 (4.5)}$$

This model is referred to as the base MNL model and incorporates explanatory variables with only main effects in the utility function. The two versions of the base MNL models have different scale parameters (μ_{v1} and μ_{v2}). Identification of the scale parameter is important in determining whether differences in parameter estimates across data sets are unconfounded with the differences in scale. The test of data pooling is motivated by the fact that data fusion provides more information for model estimation. Following Hensher and Bradley (1993) and Louviere et al. (2000), an artificial nested logit model is used in this application to identify the relative scale parameter between two versions of CE treatments. In the nested logit model, each version of the data set represents a branch of the artificially constructed tree. The inclusive value estimate represents the relative scale parameter. To test for equal taste by controlling for difference in

scale, the scale of the first data set is fixed to 1 and the scale for the second data set is estimated (i.e. the relative scale factor of μ_{v2} relative to μ^{v1} while assuming $\beta_{v1}=\beta_{v2}$ is estimated).

Since the respondents are randomly assigned to each version and complete choice tasks in a similar decision-making process, it is expected that the estimated coefficients for the main variables between two subsamples are not significantly different if there is no statistical difference in sample characteristics between the two subsamples. If the null hypothesis of taste parameter equivalence cannot be rejected, the pooled data sets will be modelled in the relevant discrete choices. The model specification for the base MNL model using pooled data is the same as that for version 2 (Equation 4.5).

To test whether the introduction of the verified free run attribute has any adverse impact on consumers' preference for the free run attribute, marginal WTP for the free run attribute across the two versions is compared. If the null hypothesis is not rejected, then it indicates that the introduction of the verified free run attribute has no significant effect on consumers' preferences for the free run attribute between the two data sources.

4.3.1.2 MNL model including interaction terms between attributes

The valuation of some attributes might be closely related to the presence of others. Thus, two-way interaction effects between the main attributes are taken into account in the model specification as follows:

$$V_{nit} = \alpha_0 * asc\_n_{nit} + \alpha_r * asc\_reg_{nit} + \beta_1 price_{nit} + \beta_2 brown_{nit} + \beta_3 fr_{nit} + \beta_4 org_{nit} + \beta_5 vfr_{nit} + \beta_6 omg_{nit} + \beta_7 vitam_{nit} + \beta_8 pasteu_{nit} + \sum_j \beta_j \left(x_{nkt} * x_{njt,\, j \neq k} \right) \quad (4.6)$$

where $x_{nkt} * x_{njt,\, j \neq k}$ denotes two-way interaction variables that enter into the model in a multiplicative way by combining two attribute variables from different types of egg attributes. The remaining variables are identically defined as those in the main effect model. If β_j is

identified to be significantly different from zero, it indicates that consumers' preferences for the relevant attribute level depends on the presence of another attribute level. A likelihood ratio (*LR*) test is used to determine whether the interaction MNL model significantly improves the goodness of fit.

4.3.1.3 Extended MNL model with respondents' characteristics

To examine individual heterogeneity in preference for egg attributes in the MNL model, an extended MNL model was specified that incorporates explanatory variables regarding socio-demographic and attitudinal characteristics of the respondents and captures systematic heterogeneity across sample groups. Since respondents' characteristics are invariant across the choice alternatives, these variables enter the utility model by interacting with attribute variables. Thus, the indirect utility function in the extended MNL model for the pooled data sets is shown as:

$$V_{nit} = \alpha_0 * asc\_n_{nit} + \alpha_r * asc\_reg_{nit} + \beta_1 price_{nit} + \beta_2 brown_{nit} + \beta_3 fr_{nit} + \beta_4 org_{nit} + \beta_5 vfr_{nit} + \beta_6 omg_{nit} + \beta_7 vitam_{nit} + \beta_8 pasteu_{nit} + \sum_j \beta_j \left(z_n * x_{nit} \right) \quad (4.7)$$

where z_n represents the socio-demographic and attitudinal variables (e.g. income and health attitude), which are interacted with different attributes of egg alternatives, x_{nit}; β_j represents the associated parameters of the interaction variables, which represent the systematic heterogeneity across the sample. While the extended MNL model is better at interpreting the sources of preference heterogeneity, it is subject to Independently and Identically Distributed (IID) errors. The IID assumption implies Independence of Irrelevant Alternatives (IIA), such that the ratio of probabilities of choosing one alternative over another is unaffected by the presence or absence of any additional alternatives in the choice set, which is unrealistic in the egg choice task. For instance, the addition of the verified free run egg choice might affect the probability of a

respondent with concern for animal welfare choosing free run eggs over omega-3 enhanced eggs, given that the verified free attribute is a proxy for animal welfare.

In addition, the MNL model assumes that egg consumers share homogeneous preferences for egg attributes, suggesting that all the estimated coefficients on the included variables in the utility function are the same for all consumers. Such an assumption might be unrealistic, as recent egg research has identified that Canadian egg consumers possess heterogeneous preferences (Goddard et al. 2007; Romanowska 2009). Furthermore, although the extended MNL model to some extent contributes to the interpretation of preference variability by explicitly incorporating covariates into the utility model, it still cannot fully capture preference heterogeneity (e.g. unobserved taste heterogeneity). Consequently, the mixed logit (ML) model is employed to account for preference heterogeneity among respondents.

Mixed Logit Model

The ML model allows for random parameter variation over the population, and is the most flexible discrete choice model to represent a random utility model (McFadden and Train 2000; Train 2003). The ML model is free of the IIA property implied by the IID assumption and allows correlation in the unobserved utility in the choice experiment (Revelt and Train 1998; Train 1998; Train 2003). With this model, the heterogeneity in consumer preferences for egg attributes can be estimated explicitly. In this study, it is postulated that the taste coefficients vary among respondents, but are constant across four choice sets for each respondent. This reflects an underlying assumption of stable preference structures for all respondents (Train 2003).

The utility of respondent *n* choosing alternative *i* in the choice set *t* could be represented as:

$$U_{nit} = \beta_n x_{nit} + \varepsilon_{nit} \tag{4.8}$$

where x_{nit} is a vector of observed variables. β_n is a vector of individual-specific coefficients that are unobserved and randomly distributed with density $f(\beta_n | \theta)$, where θ refers to the true parameters of the taste distribution (Revelt and Train 1998; Train 1998; Train 2003). ε_{nit} is a random term that is an IID type I extreme value, independent of β_n and x_{nit} . β_n can be decomposed into a mean β and a standard deviation parameter η_n that measures unobserved taste to reveal the existence of preference heterogeneity. Given a specific distribution for β_n (e.g. normal, log-normal, triangular, or uniform), the focus of the ML model analysis is on the estimation of both a mean and a standard deviation parameter.

As β_n is unknown to the researcher, thus the choice probability of a respondent *n* choosing alternative *i* in the ML model is the integral of the standard logit probability over all possible values of β_n, which can be expressed as:

$$P_{ni}(\theta) = \int L_{ni}(\beta) f(\beta_n | \theta) d\beta \tag{4.9}$$

where $L_{ni}(\beta)$ represents the logit probability, which is conditional on β. In this application, it is assumed that all non-price attribute parameters are randomly distributed. By fixing the price coefficient, the derived WTP estimates will have an identical distribution to the attribute parameter. From a technical perspective, the MNL model is a degenerated version of the ML model where $f(\beta_n | \theta)$=1 and β_n=β.

Compared to the MNL model, the probability expression of the ML model does not take a closed form, so the Simulated Maximum Likelihood Estimation (SMLE) is applied for estimation (Train 2003; Hensher et al. 2005). Readers are advised to refer to Louviere et al. (2000), Train (2003) or Hensher et al. (2005) for details about the simulation procedure of the ML model.

Willingness to Pay

Estimated parameters on attributes from the discrete choice model provide little interpretation in terms of preference strength. The willingness to pay (WTP) of an individual is thus more appropriate in comparing the intensity of consumers' preference for individual egg attributes by converting attribute coefficients into the same scale of measurement. The marginal WTP is generally defined as the net income change that equals a change in quality or quantity of a product. Thus, the economic interpretation of the marginal WTP from the utility function is straightforward. The marginal WTP is a marginal price change associated with a marginal change in a specific attribute while keeping the utility constant. As the attribute variables are dummy coded in this study, the marginal WTP can be calculated as the negative ratio of the estimated parameter on the given attribute to the price parameter, which is represented as:

$$WTP_i = -\frac{\beta_i}{\beta_{price}} \tag{4.10}$$

where β_i represents the individual coefficient on the attribute variable x_i (excluding the variable *price*); β_{price} is the parameter on the variable of *price*. WTP_i represents the premium that respondents are willing to pay for alternative egg attribute level x_i relative to the base level. In this application, standard errors of the WTP estimates are calculated by using the Delta method (Greene 2003).

In addition, a Wald test is used to test the significance of the difference in WTP for the free run attribute between two versions, which is expressed as:

$$WTP_{fr}^{v1} - WTP_{fr}^{v2} = \left(-\frac{\beta_{fr} + \beta_{version1*fr}}{\beta_{price} + \beta_{version1*price}} \right) - \left(-\frac{\beta_{fr}}{\beta_{price}} \right) \tag{4.11}$$

If the coefficient of marginal WTP difference variable is not significantly different from 0, it indicates that respondents from both versions assess the free run attribute in a similar manner.

4.4 Conclusion

The CE approach allows the estimation of the value of egg attributes. Under the conceptual framework of RUT, a series of discrete choice models are developed to address the major research objectives. To achieve the research objectives, the MNL model and the ML model are elaborated on by progressively relaxing key assumptions. The analysis stays focused on the advantages and limitations of each model while taking advantage of their merits to investigate egg consumers' preference (e.g. preference homogeneity versus preference heterogeneity). Model results and analysis with regard to these types of choice models are presented in Chapter 6. The next chapter presents a descriptive analysis of the remaining survey data.

CHAPTER 5
DESCRIPTIVE ANALYSIS

5.1 Introduction

This chapter presents a descriptive analysis of respondents beginning with socio-demographic traits of the sample as compared with the 2006 Canadian census. Second, survey results pertaining to different aspects of respondents' characteristics and attitudes towards egg purchasing are examined. Last, a summary of the characterization of respondents is provided in the conclusion section.

5.2 Demographic Characteristics of the Respondents

In total, 647 subjects participated in the survey, of which 321 completed the first version and 326 completed the second version. Socio-demographic characteristics of respondents and the 2006 Canadian census are presented in Table 5-1. As expected, the null hypothesis of equality of means across treatments cannot be rejected for each demographic characteristic reported. Generally speaking, this sample is representative of the Canadian population (excluding Quebec) in household size and marital status. The age of the respondents is slightly higher than that of the Canadian population, which is expected in that individuals had to be at least 18 years old to participate in the survey. The number of minors in the household and household income are slightly underrepresented in the sample relative to the Canadian population. More females responded than males, likely because women tend to be primary household shoppers. In addition, the sample population is slightly more educated than the Canadian population, which is a typical bias in internet-based samples. According to the 2009 Canadian Internet Use Survey, 89% of Internet users have achieved at least some post-secondary education (Statistics Canada 2009).

Table 5-1. Demographic characteristics of the sample

Demographic variables	Description	Version 1 (n=321)	Version 2 (n=326)	Total (n=647)	Canada census 2006
		Mean (S.d.)	Mean (S.d.)	Mean (S.d.)	Mean
Gender	1=Female,0=Male	0.62 (0.49)	0.62 (0.49)	0.62 (0.49)	0.51
Age	Age of participants	49.62 (15.89)	48.89 (15.60)	49.25 (15.75)	45.70
Household size	Number of family members in the household	2.49 (1.18)	2.47 (1.21)	2.48 (1.19)	2.49
Household income ($)	Mid-point figure of each category of household income	65537.4 (34179.3)	63987.7 (33456.8)	64756.6 (33824.4)	69548.4
Children	Number of children younger than 18 in the household	0.40 (0.79)	0.42 (0.84)	0.41 (0.81)	0.55
Marital status	1 if married/living with a partner/ common law, 0 if single/windowed	0.65 (0.48)	0.65 (0.48)	0.65 (0.48)	0.61[a]
Education	1=High school (completed or not) 2=Certification or diploma below the bachelor level 3=University degree at bachelor's level or above	2.09 (0.72)	2.10 (0.73)	2.09 (0.73)	1.83[b]

Adapted from Statistics Canada 2006.
[a] Note: marital status of Canada 2006 applies to the population 15 years of age and over.
[b] Note: the grouping of highest education attainment differs from this survey because education data in the census was collected from the population aged 25 to 64.

The representativeness of the sample by province versus the Canadian population is displayed in Figure 5-1. Quebec is excluded from the comparison, since this survey was designed and launched only in English. It is clearly shown in the figure that the surveyed sample is representative of the Canadian population (with the exception of Quebec) in terms of provincial distribution.

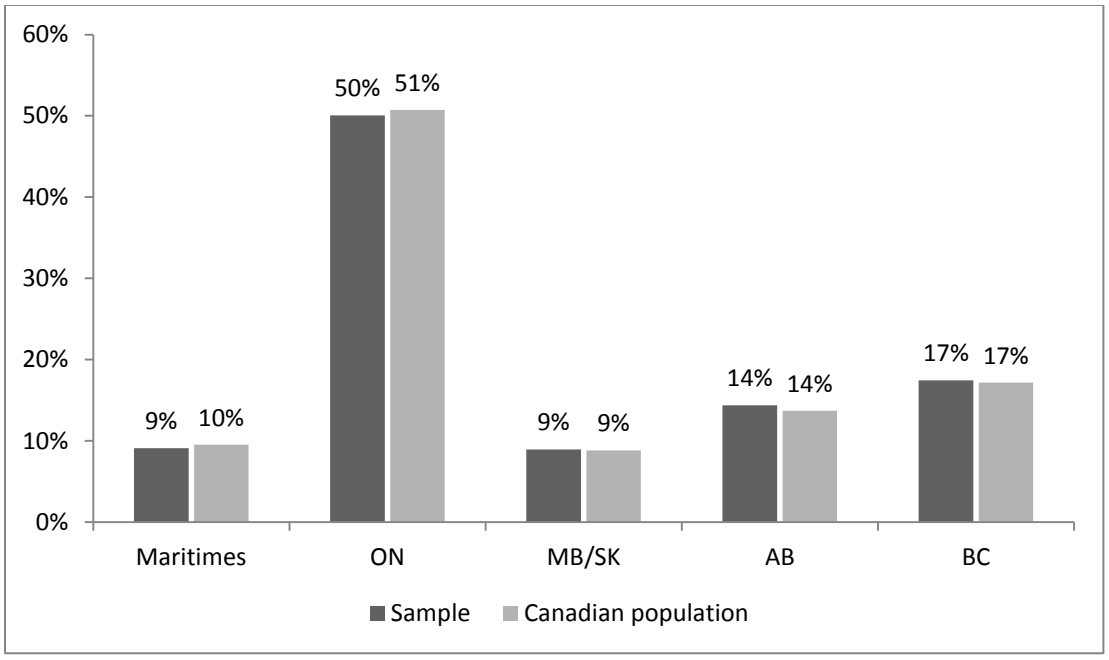

Figure 5-1. Provincial distribution of the survey samples compared to Canadian population (excluding Quebec) (source: Statistics Canada 2006)

5.3 Egg Shopping Habits

Approximately 40% of respondents reported that they usually purchased eggs at least once per week in the past six months (Figure 5-2). This result is not surprising in that a screener question is included to exclude those who had not purchased eggs in the past six months. A majority of respondents bought eggs by the dozen at the point of purchase (Figure 5-3).

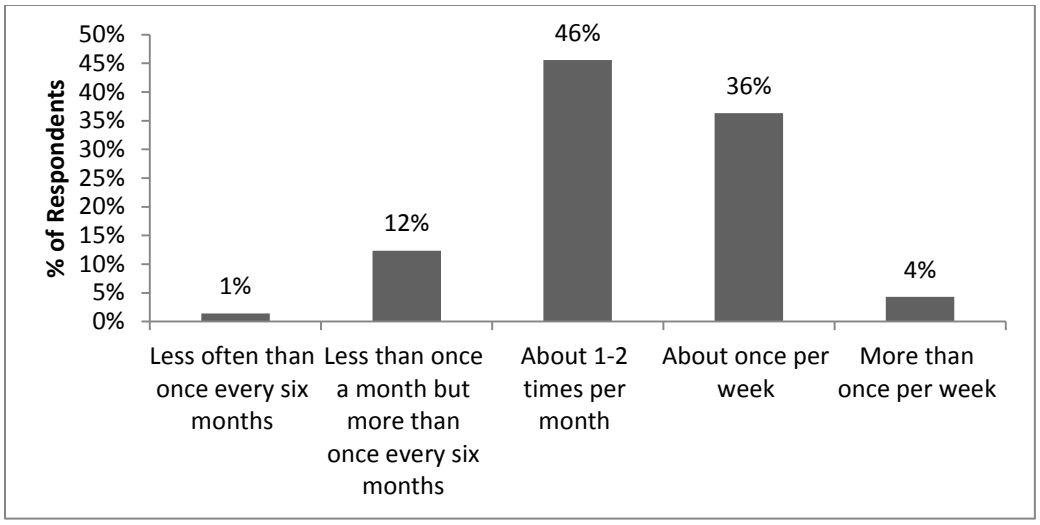

Figure 5-2. Frequency of purchasing eggs in the past six months

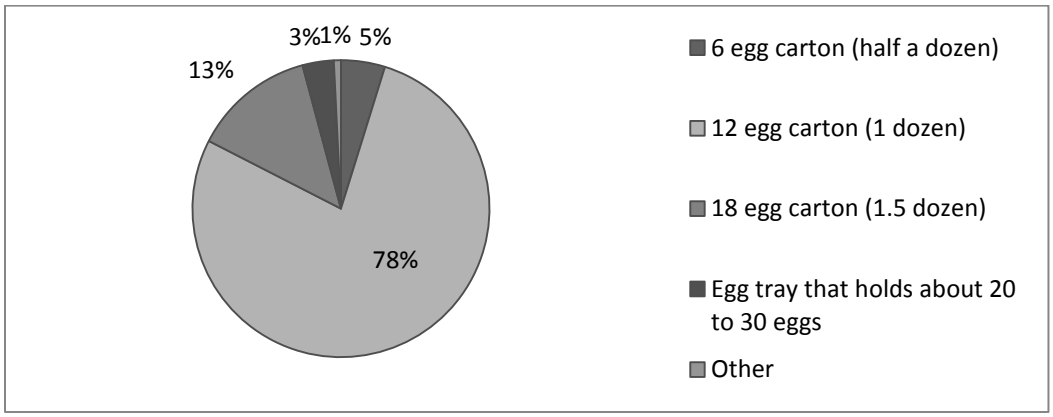

Figure 5-3. Package size of eggs most frequently purchased by respondents

With regard to purchasing location, supermarkets/grocery stores remain the regular shopping place for approximately 86% of respondents, with farmers' markets being regularly chosen by only 4% of respondents (Figure 5-4).

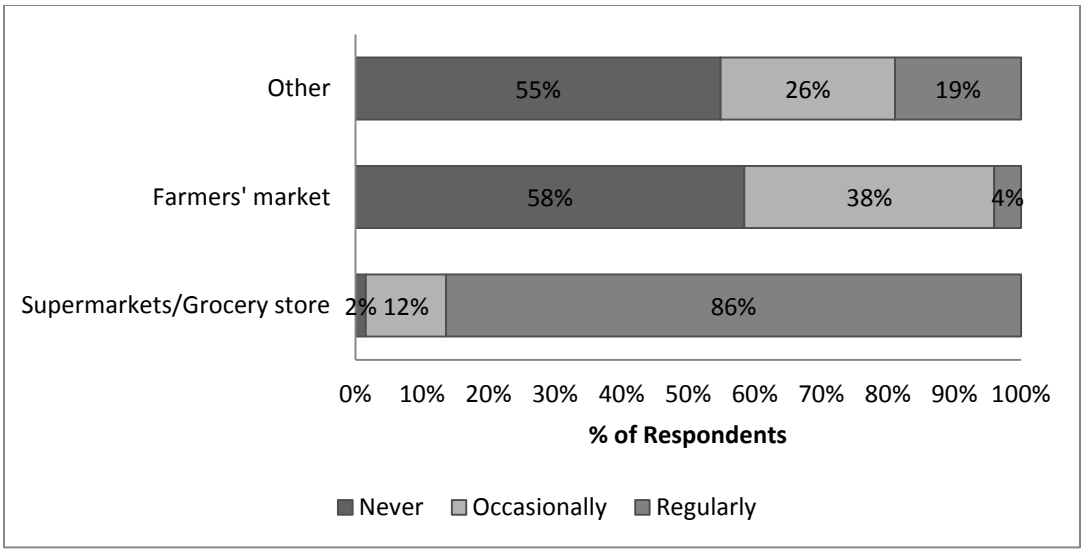

Figure 5-4. Egg purchasing locations by respondents

Several questions regarding egg products are used to obtain information on respondents' egg shopping habits relating to price, shell colour and egg types. Since egg price varies by package size and a dozen is the most commonly used package, only survey data with regard to egg price by the dozen is reported (n=503). Among all the respondents who most frequently purchased eggs in 1-dozen packages, around 80% of respondents usually paid from $2.00 to $4.00 per dozen eggs (Figure 5-5). White eggs were more popular than brown eggs: approximately 65% of respondents normally bought white eggs while only 14% of respondents normal bought brown eggs (Figure 5-6). This result might reflect the relative availability of white and brown eggs in the Canadian market.

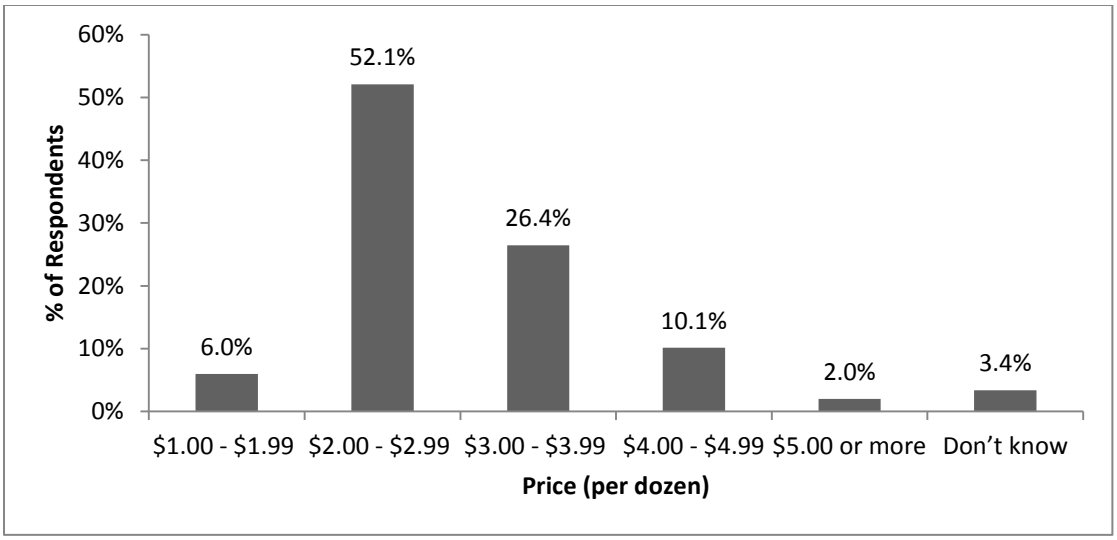

Figure 5-5. Price for per dozen of eggs

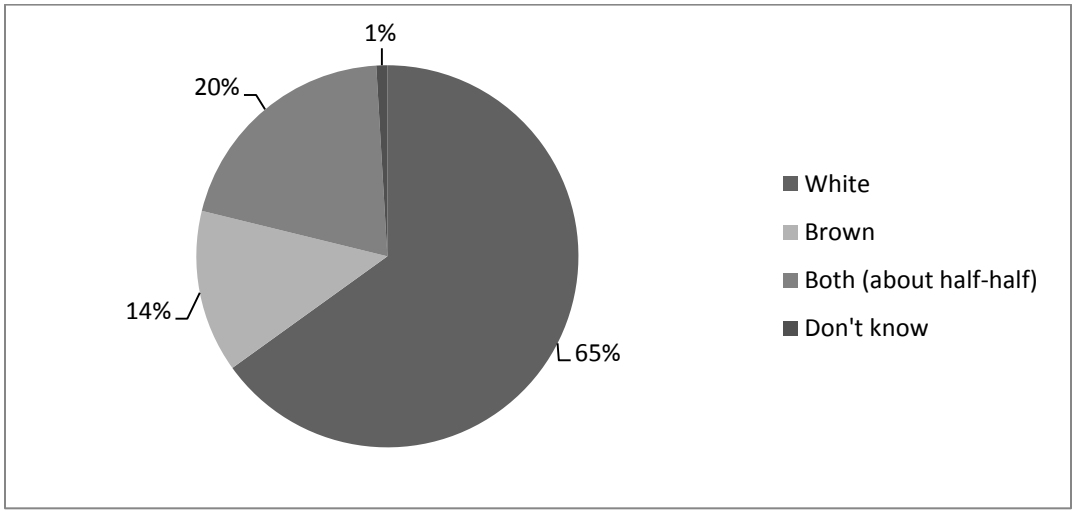

Figure 5-6. Colour of eggs respondents normally bought

When it comes to the types of eggs respondents habitually buy, the vast majority of respondents were used to buying one type of eggs, among which were regular eggs, followed by omega-3 enhanced eggs, free run eggs, organic eggs and vitamin-enhanced eggs (Figure 5-7). The results relating to the proportion of eggs most often bought by respondents to a certain extent reflected the market share of various egg products in the market, particularly with respect to the dominance of regular eggs.

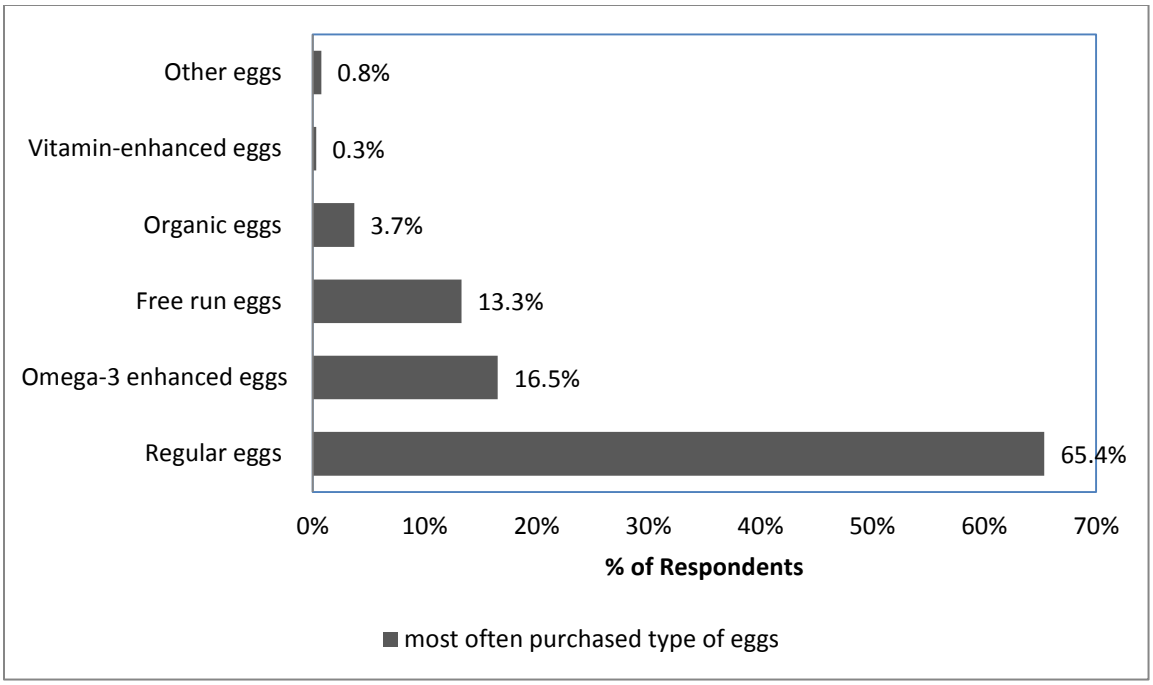

Figure 5-7. Types of eggs most often purchased

5.4 Food Safety, Risk and Health Attitudes

A large proportion of respondents perceived food products as safe (Figure 5-8). However, this result should not be interpreted that they were not suspicious about certain food products as a result of the occurrence of food safety incidents. About half of respondents expressed suspicion about certain food products as a result of the occurrence of food safety incidents. Thus, food safety perception is an issue explored in more detail in the empirical analysis.

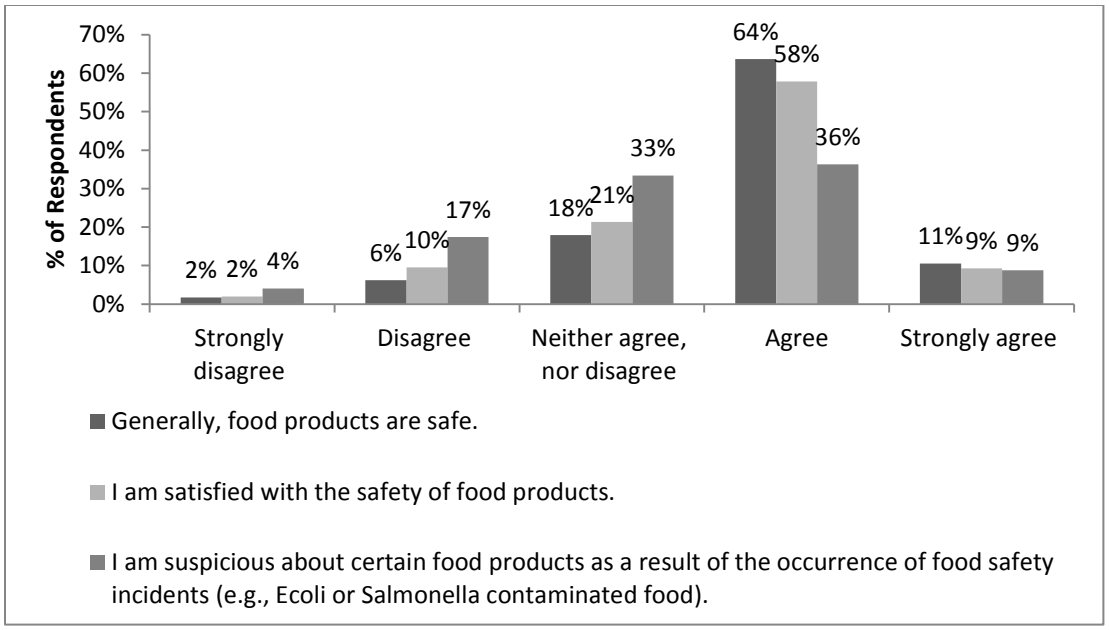

Figure 5-8. Respondents' general attitudes towards food safety

On average, regular eggs were rated safer, followed by free run eggs with organic eggs being rated least safe (Figure 5-9). Compared to other livestock products, egg products seem to be regarded as relatively safer. T-test results suggest that regular eggs and free run eggs are rated significantly safer compared to organic eggs by respondents in terms of mean difference of confidence score. However, there is no significant difference in respondents' perceptions of egg safety between regular eggs and free run eggs. This finding is understandable, since food safety of organic eggs could be compromised by exposure of hens or eggs to wild birds and diseases. Since respondents were quite confident about the safety of regular eggs, it might imply that egg consumers would place relatively less value on the attribute with enhanced safety, such as pasteurization.

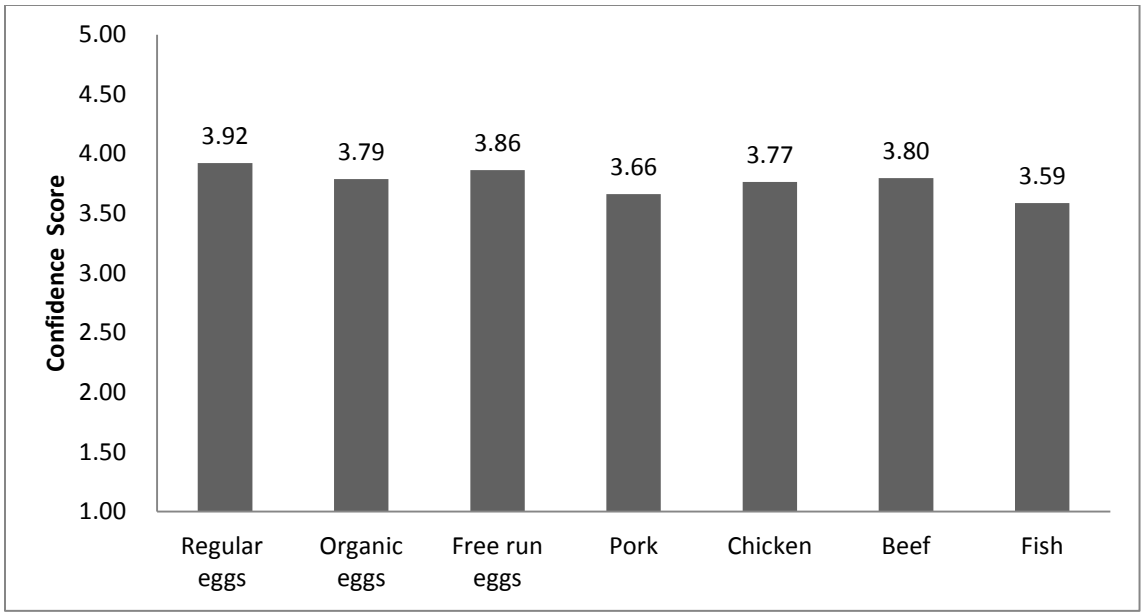

Figure 5-9. Average score of confidence in the safety of product groups by respondents

Approximately 10% of respondents felt concerned about the risk of eating eggs and half of respondents agreed or strongly agreed that eating eggs is an essential component of a healthy diet if they are eaten in moderation (Figure 5-10). Nevertheless, it is notable that around one third of respondents expressed concern about cholesterol levels and reduced egg consumption.

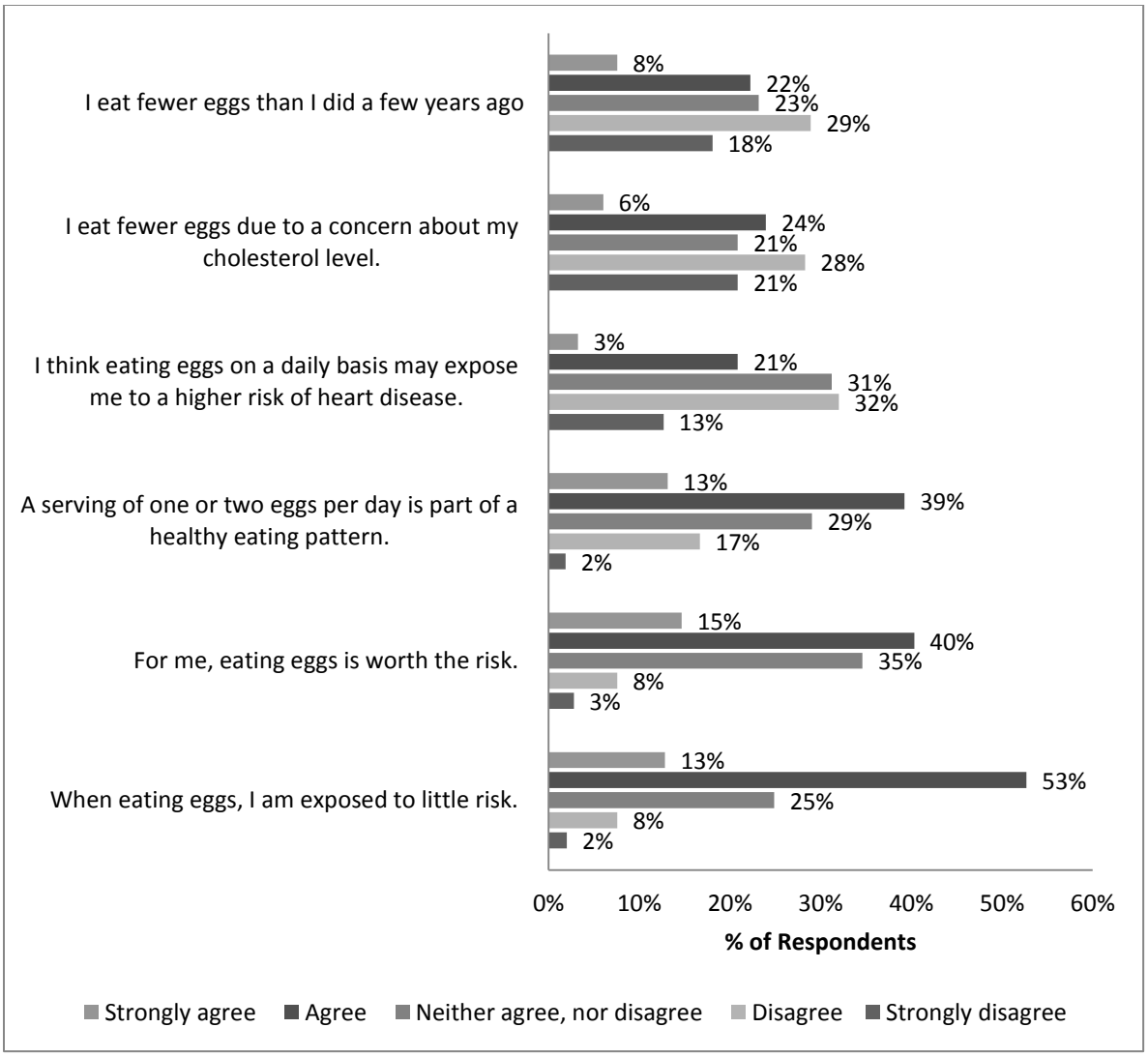

Figure 5-10. Risk perception of eating eggs

To elicit risk preferences, respondents were asked to indicate their likelihood of engaging in nine risky activities (Question 12, Section II). Responses to a set of five questions in the heath/safety domain (Question 12a-12e) and another set of four questions (Question 12f-12i) in the recreation domain were averaged. Based on the statistical results of a paired-sample mean difference t-test, mean response to the likelihood of engaging in five risky health activities (e.g. "ignoring some persistent physical pain by not going to the doctor") is significantly higher than that of four risky recreational behaviours (e.g. "traveling on a commercial airplane") (Figure 5-

11), which confirms the finding identified by Weber (2002) that people's risk attitude is domain-specific instead of homogeneous. In other words, people's risk attitude is not consistent and depends on the specific category of risk activities or behaviours. Summation of five 5-point Likert scale rating items associated with the likelihood of engaging in health-related behaviours will be used to help examine the impact of risk preference on the assessment of egg attributes.

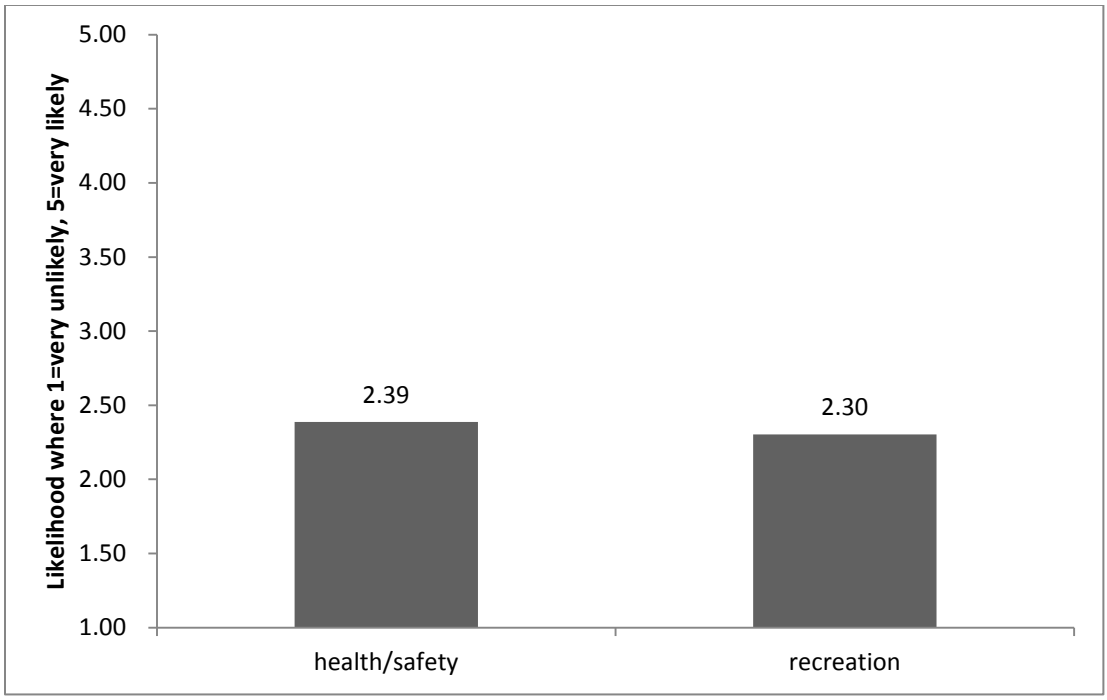

Figure 5-11. Risk preference associated with health and recreational behaviours

Approximately 30% of respondents reported members of their household to have adverse health conditions including high blood pressure and high cholesterol (Figure 5-12).

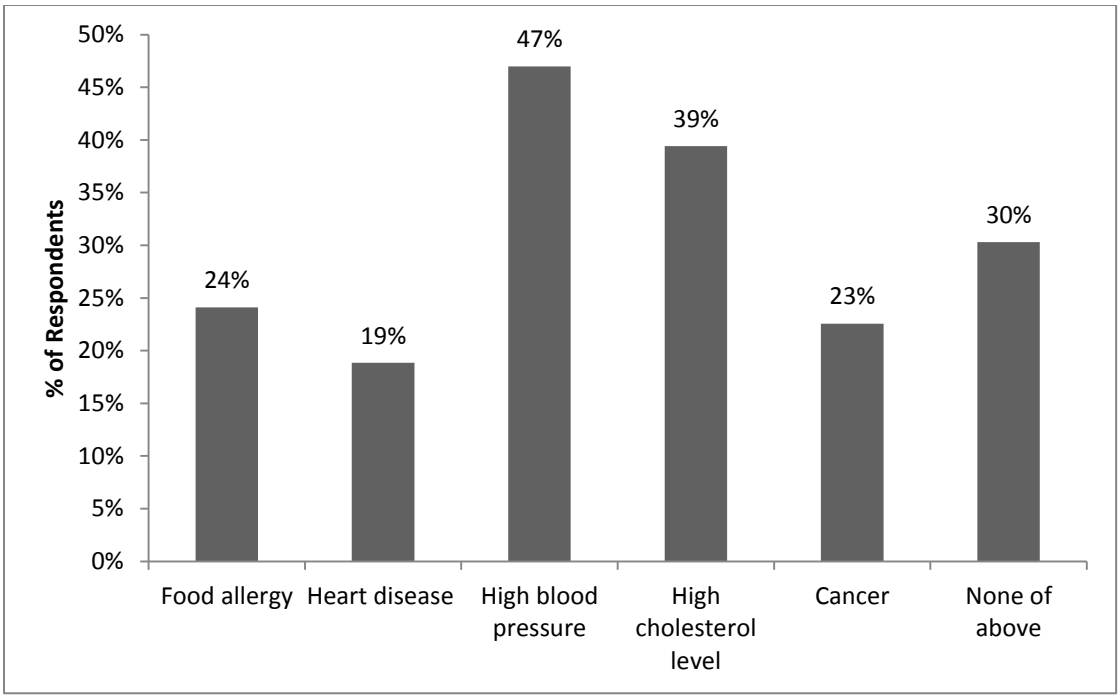

Figure 5-12. Health conditions of respondents' household members

In regard to respondents' health behavior and awareness, the majority of respondents were certain that regularly exercising and taking vitamin supplements were important components of a healthy lifestyle (Figure 5-13). Most respondents were used to reading nutrition labeling information when they intended to buy new pre-packaged foods. More respondents were more likely to agree with the statements that their health was much better compared to others their age; they also reported to be well aware of the relationship between health and nutrition, and that eating foods fortified with vitamins or omega-3 is important.

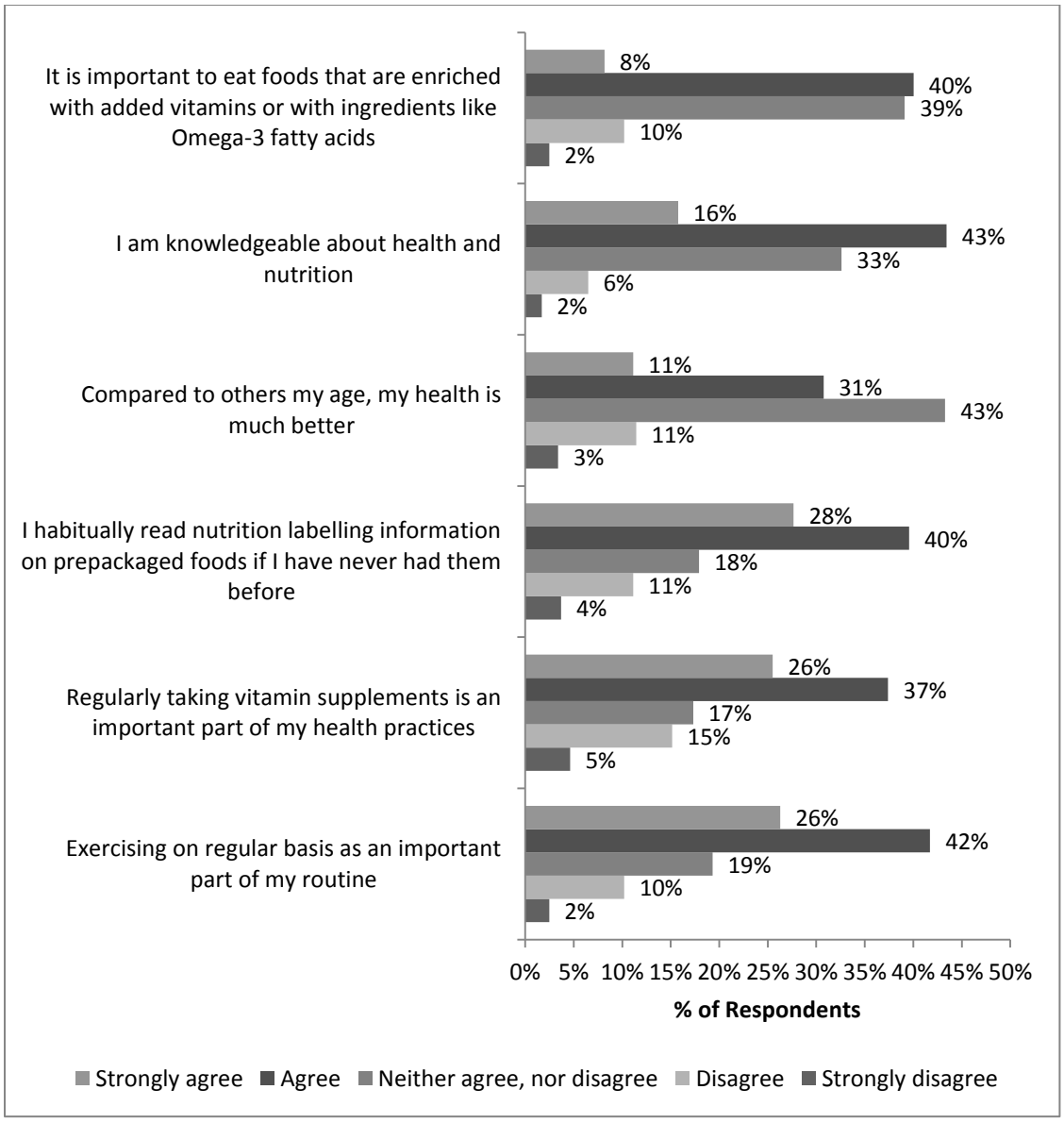

Figure 5-13. Health behavior and awareness of respondents

The health locus of control was constructed to assess the extent to which people think they can control their own health. The three statements correspond to each dimension, which was designed to evaluate the degree to which people believe their health is determined by themselves, others or by luck. It is noteworthy that most respondents agreed or strongly agreed with the statements that they could avoid illness if they took care of themselves (Figure 5-14). Respondents expressed uncertainty about whether their health depends on their physician or

good fortune. Respondents were most ambivalent in agreeing or disagreeing with these two statements.

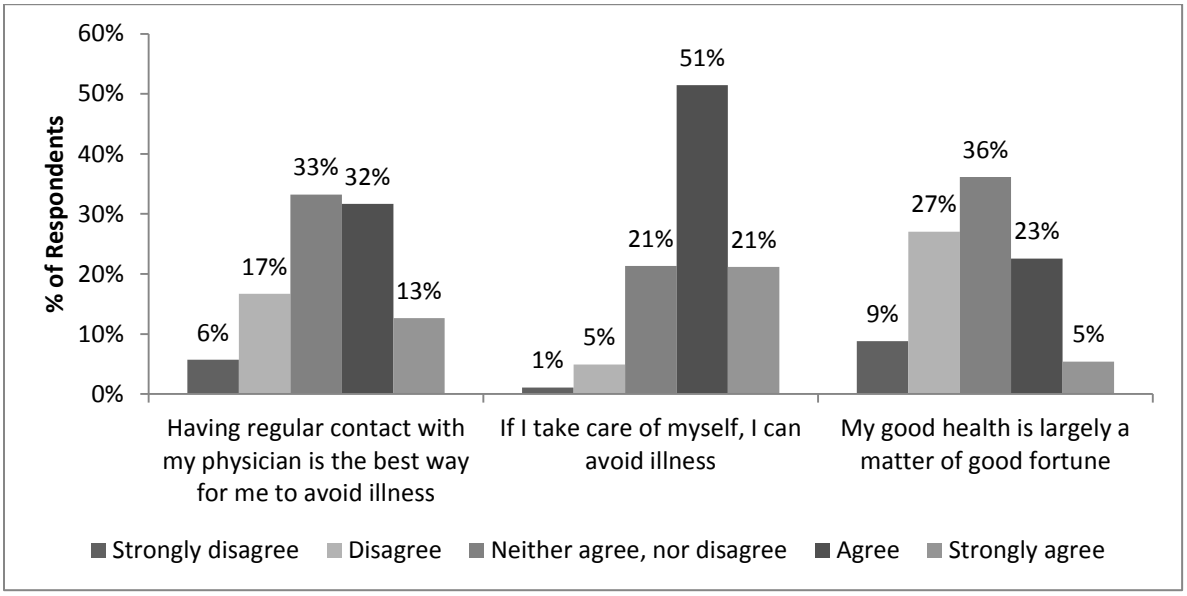

Figure 5-14. Health locus of control over respondents' health

5.5 Knowledge of Eggs and Barriers to Purchasing Specialty Eggs

Respondents' rating of their knowledge of eggs by means of a five-point Likert scale is averaged to construct an index of knowledge score. As anticipated, respondents were most familiar with regular eggs and least familiar with pasteurized eggs (Figure 5-15), which are not available Canada. Among other specialty eggs, respondents were relatively more familiar with free run eggs, organic eggs and omega-3 enhanced eggs compared to vitamin-enhanced eggs and eggs from hens fed only vegetarian feed. It is expected that respondents' WTP for different types of eggs might be correlated with their knowledge of egg products.

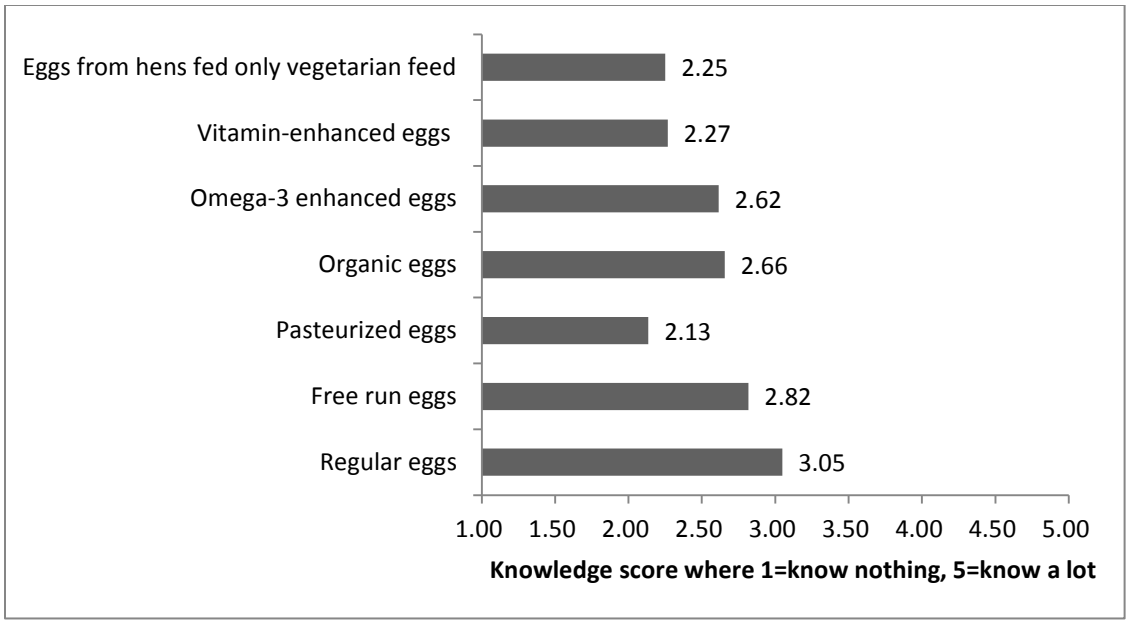

Figure 5-15. Mean knowledge score of survey respondents to different types of eggs

As illustrated in Figure 5-16 and Figure 5-17, the lack of product availability in grocery stores and the absence of third-party verification and/or certification could be key barriers to expanding market shares of free run and omega-3 enhanced eggs compared to other kinds of specialty eggs. More than half of respondents claimed they would buy or buy more free run eggs if the egg production practices were verified or certified by third-party organizations. However, caution should be exercised in that consumers' stated purchasing behaviours might not be consistent with their actual purchasing behaviours, since there might exist a wide variety of unobserved factors affecting consumers purchasing decision in real settings, such as time limit, budget constraint and purchasing habits.

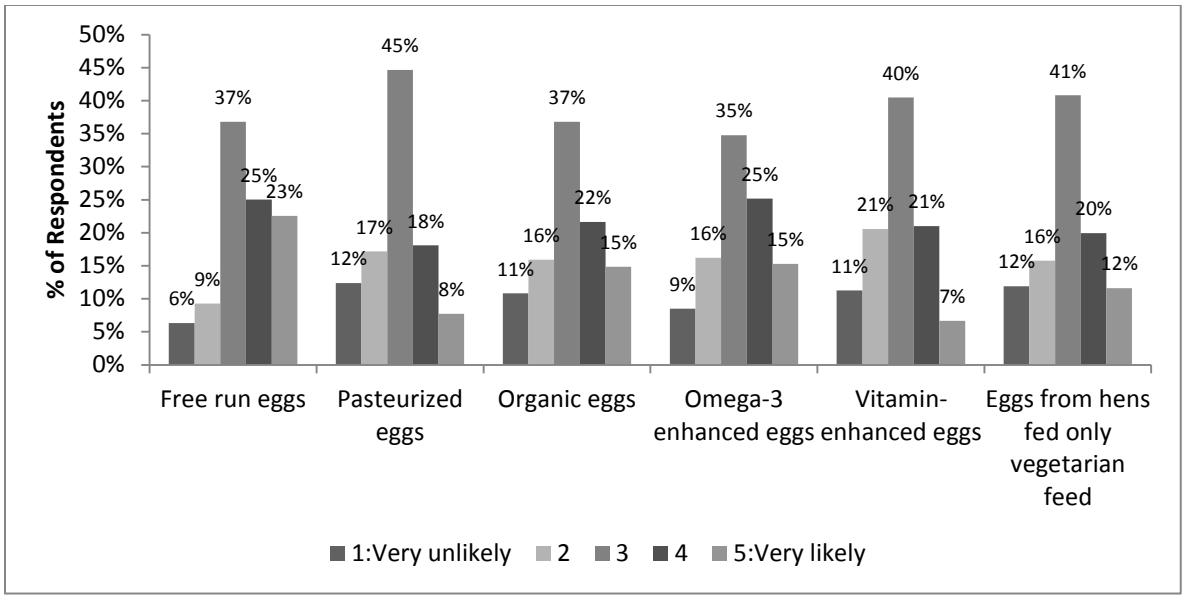

Figure 5-16. Likelihood of purchasing specialty eggs if they become available or more available in superstores/grocery stores

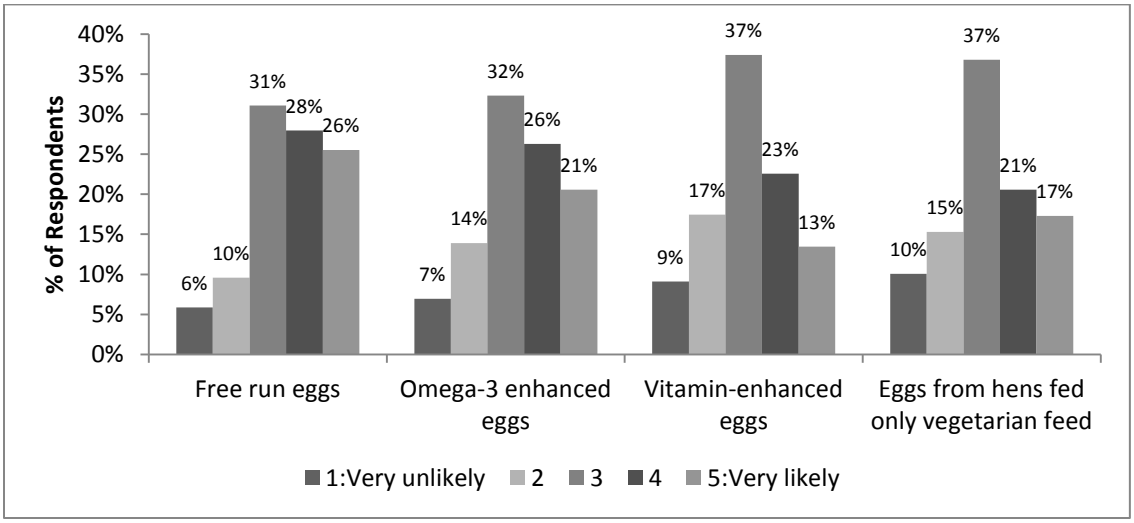

Figure 5-17. Likelihood of purchasing specialty eggs if their production process are verified or certified by a third-party organization

5.6 Perceptions of Egg Quality and Attributes

Respondents were asked to state their agreement with statements about egg quality, the results of which are depicted in Figure 5-18. Respondents reported uncertainty over the safety of pasteurized eggs with around 70% of them unsure or dismissing safety improvements associated with pasteurized eggs. Respondents were also relatively ambiguous about the shell colour of free

run eggs (61% yes and don't know) and the nutrition of brown eggs (40% yes and don't know). In general, respondents revealed substantial misperceptions of food quality, which is in line with the findings of other Canadian egg research in that consumers perceived dark-yolked, organic and brown eggs to have higher nutritional values than white eggs (Goddard et al. 2007; Bejaei 2009).

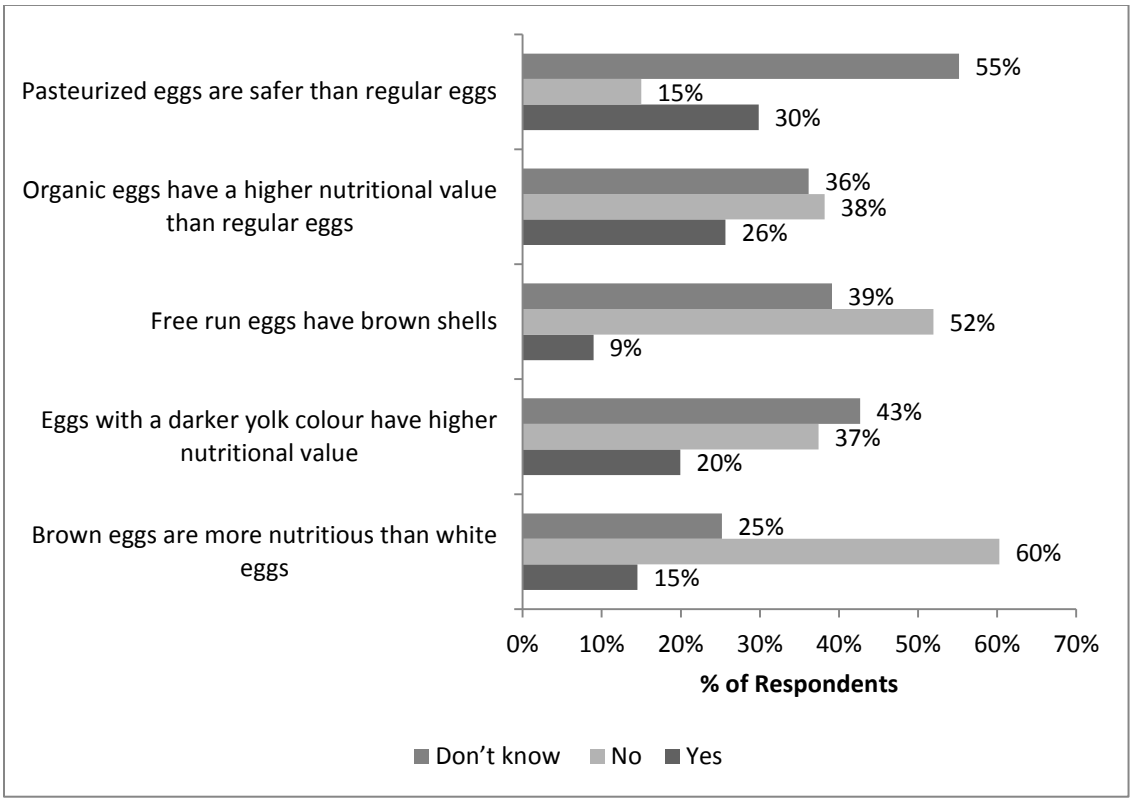

Figure 5-18. Frequency of perceptions of objective quality

When it comes to the perception of quality, around half of respondents indicated that free run or organic eggs were healthier than regular eggs; approximately one third of respondents were certain that free run or organic eggs tasted better than regular eggs; and eggs with a darker yolk colour tasted better (Figure 5-19). Many respondents were uncertain whether mishandling eggs at home was the major reason for the 2010 salmonella outbreak caused by tainted eggs in the US. Only a small proportion of respondents believed that free run and organic eggs were more likely

to be contaminated by salmonella bacteria. There is a substantial divergence of opinions that eggs with a dark yolk colour taste better.

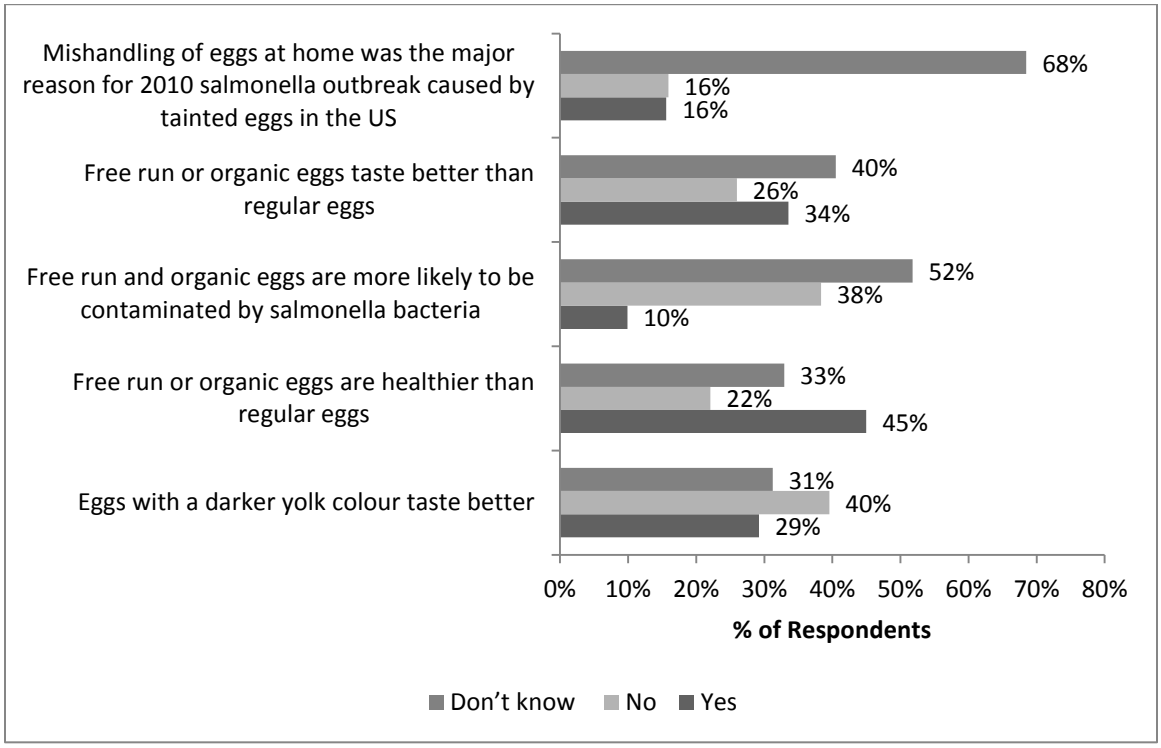

Figure 5-19. Frequency of perceptions of subjective quality

Overall, respondents were heterogeneous in their perceptions of egg quality. Some respondents did not consider the attributes of free run and organic separately from other desirable attributes (e.g. taste and health).

5.7 Conclusion

In conclusion, this chapter provides a detailed descriptive analysis of the survey data pertaining to respondents' egg purchase behaviours and attitudes. Overall, the sample is representative of the English-speaking Canadian population. Graphical analysis of respondents in terms of egg purchasing habits, food safety and risk attitudes and perceptions of egg quality and attributes provides insights into consumer preferences. Some variables pertaining to consumers' characteristics and attitudes towards egg quality are included in the choice analysis to explain the

difference in consumers' response to egg attributes. Furthermore, respondents displayed distinctly different preferences and attitudes pertaining to different types of eggs and revealed that they evaluate various attributes of egg products in different manners. Heterogeneity in socio-demographic characteristics and attitudinal responses were markedly revealed among respondents. The next chapter provides a more detailed examination of preference heterogeneity and consumers' attitudes toward egg attributes using econometric modeling.

CHAPTER 6
MODEL RESULTS AND ANALYSIS

6.1 Introduction

This chapter presents estimation results from the choice models and relevant hypotheses developed in Chapter 4 to deal with the proposed research questions: (1) How do different types of egg attributes affect consumers' purchasing decisions for quality-differentiated eggs? (2) To what extent do preferences for egg attributes vary among people, and how do individual's attitudes and socio-demographic characteristics influence their egg choices? (3) Does the inclusion of a verified free run attribute (versus simply free run) make a difference across the two versions of the survey?

The econometric software NLOGIT 4.0 written by Greene is applied for model estimation following Figure 4-1 in Chapter 4. The estimated models can be classified into two streams based on the preference assumptions:

(1) The base MNL models that assume preference homogeneity: (1a) the base MNL model with main effects; (1b) the base MNL model with two-way interaction effects.

(2) Two alternative choice models that take account of preference heterogeneity: (2a) an extended MNL model with respondents' characteristics; (2b) the ML model.

6.2 Estimation Results of the Multinomial Logit Model

In this section, the results regarding two hypothesis tests are first presented, followed by the base MNL model with main effects and the estimation results for the base MNL model that contains significant two-way interaction variables between shell colour and other attributes.

Hypothesis Testing

In order to test for preference equality across treatments and estimate the relative scale parameter in the joint model, an artificial nested logit model outlined by Hensher and Bradley

(1993) was applied in a full information maximum likelihood (FIML) manner. In the joint model, where the version 1 scale parameter is normalized to be 1, the parameters on common attributes are restricted to be the same between the two CE treatments. Estimation results are presented in Table 6-1 where all variables names are as specified in Table 4-1.

Table 6-1. Base MNL model estimates for pooled data sets controlling for scale difference

Variables	Coefficient	P-value
ASC_N	-3.087***	.000
ASC_REG	.350***	.000
PRICE	-.528***	.000
BROWN	.156***	.010
FR	.681***	.000
ORG	.425***	.000
VFR	.360***	.002
OMG-3	.315***	.000
VITAM	.253***	.003
PASTEU	.203***	.001
Summary statistics		
Scale parameter		.735
McFadden R2		.477
Log-likelihood		-2814.436
LR statistics		.064
Number of obs.		2588

Note: ***, **,* denotes significance at the 1%, 5%, 10% level.

The scale parameter is 0.735, which is not significantly different from unity (p-value=.789). Thus, we fail to reject the null hypothesis of parameter equality subject to scale heterogeneity,

since the chi-squared statistic for the hypothesis of equal parameters (*LR* statistics) is .064, which is less than the critical values $\chi 2$ (1) (3.841) at the 5% level. Hence, when allowing for scale heterogeneity, the underlying parameters in the base MNL model are not significantly different between the two versions of CE responses. Therefore, the data are pooled for all subsequent analysis.

To examine whether the introduction of the verified free run attribute has any adverse or negative effect on consumers' evaluation of free run without verification, the marginal WTP for free run is compared between the treatments. Based on the Wald test for marginal WTP difference, the null hypothesis of equality of marginal WTP for the free run attribute between treatments was rejected at the 10% significance level (p-value=.079). The test result indicates that introducing the verified free run attribute has a weakly significant negative effect on respondents' valuation. This finding is expected and intuitive, it is speculated that due to skepticism towards the authenticity of free run eggs without verification in the presence of verified free run eggs, some respondents were either unwilling to pay or lowered their WTP for unverified free run eggs, which can be referred to as the "externality or stigma effect".

Base MNL Model Results

Table 6-2 presents the estimated results for the base MNL model, which is obtained from the empirical specification of Equation (4.5).

Table 6-2. Base MNL model results

Variables	Coefficient	P-value
ASC_N	-2.971***	.000
ASC_REG	.310***	.001
PRICE	-.523***	.000
BROWN	.005	.933
FR	.824***	.000
ORG	.638***	.000
VFR	.618***	.000
OMG-3	.323***	.000
VITAM	.075	.373
PASTEU	.158***	.009
Summary statistics		
McFadden R2		.095
Adjusted R2		.094
Log-likelihood		-2845.285
Number of obs.		2588

Note: ***, **,* denotes significance at the 1%, 5%, 10% level.

As expected, the coefficient of the alternative-specific constant for no option (*ASC_N*) is statistically significant and negative. This suggests that respondents are more likely to choose either option A or B compared with choosing the no purchase option. The coefficient of the alternative-specific constant for regular eggs (*ASC_REG*) has a significant and positive sign, indicating respondents are more likely to choose regular eggs when all other variables are equal. It is possible that consumers might benefit from unobserved attributes inherent in regular eggs or just generally have a positive impression of regular eggs that was not captured in the choice models.

All attribute coefficients are found to be statistically significant at the 1% level with expected signs, with the exception of shell colour and vitamin-enhanced feed, which are not statistically significant. As expected, the price coefficient is negative, suggesting that an increase in egg price would reduce the probability of choosing the egg alternative.

Since all remaining attribute variables are dummy-coded, their parameter estimates have to be interpreted in relation to the base level (where eggs have white shells and come from hens kept in conventional battery cages and fed with regular feed). Consequently, a positive estimated coefficient on a specific attribute implies that respondents are more likely to choose the egg alternative with changes in that attribute, ceteris paribus.

However, estimated parameters on attributes from the discrete choice model provide little interpretation in terms of preference ordering. It is more common to calculate the marginal WTP to make comparisons of consumers' preference strength for each of the attributes by converting the attribute coefficient into the same scale of measurement (implicit price). Marginal WTP estimates and asymptotic standard errors are shown in Table 6-3, which are obtained with the coefficients reported in Table 6-2.

Table 6-3. Marginal mean WTP for each egg attribute

Variables	Marginal WTP ($/1 dozen)	P-value
BROWN	.010 (.114)	.933
FR	1.575*** (.166)	.000
ORG	1.218*** (.174)	.000
VFR	1.182*** (.230)	.000
OMG-3	.617*** (.163)	.000
VITAM	.143 (.161)	.373
PASTEU	.302*** (.116)	.009

Note: ***, **,* denotes significance at the 1%, 5%, 10% level, the numbers in parentheses are standard errors generated by using delta method in NLOGIT 4.0.

The marginal WTP estimates provide an interpretation of the relative importance of egg attributes. Free run eggs are most preferred by respondents, followed by organic eggs and

verified free run eggs. Respondents are on average willing to pay a price premium of $1.58 per dozen to purchase free run eggs relative to regular eggs while other variables are held constant. Respondents are clearly willing to pay more for the production method attribute relative to other attributes. An odd finding is that the marginal WTP for *FR* is slightly higher than the marginal WTP for *VFR* at the 10% level. It is speculated that the result might be due to the caveat that the MNL model fails to account for the unobserved preference heterogeneity associated with free run and verified free run eggs. In addition, respondents notably prefer omega-3 enhanced eggs (premium is $.62 per dozen eggs) over vitamin-enhanced eggs (no significant premium). Among the considered attributes that carry a positive premium, *PASTEU* carries the lowest premium ($.30 per dozen eggs), probably because pasteurized eggs are not available in Canada and consumers are less familiar with the quality of pasteurized eggs. Respondents are indifferent towards brown or vitamin-enhanced eggs relative to regular eggs. The results clearly show that Canadian consumers do evaluate different egg attributes in a different manner.

Generally speaking, the premiums for pasteurized eggs and free run eggs identified in this research are significantly higher than the premiums found in Romanowska's stated preference experiment where respondents' WTP for uncertified pasteurized eggs and uncertified free run eggs are negative and zero respectively compared to regular eggs. For vitamin-enhanced eggs, the identified zero premium from this research is same as that of Romanowska's stated preference research.

While the base MNL model with main effects reveals consumers' preferences for egg attributes, it fails to take into consideration the potential correlation of attributes. Therefore, the base MNL model with two-way interaction effects is considered next.

Base MNL Model Including Interaction Terms between Attributes

After extensive exploration of model testing, the estimated results of the base MNL model with significant two-way interaction terms are reported in Table 6-4.

Table 6-4. Base MNL model with two-way interaction effects for the egg attributes

Variables	Coefficient	P-value
ASC_N	-3.279***	.000
ASC_REG	-.005	.967
PRICE	-.520***	.000
BROWN	-.756***	.000
FR	.603***	.000
ORG	.190	.159
VFR	.348*	.048
OMG-3	.347***	.000
VITAM	-.090	.294
PASTEU	-.062	.541
BROWN*FR	.503***	.012
BROWN*ORG	.974***	.000
BROWN*VFR	.457*	.064
BROWN*PASTEU	.514***	.002
Summary statistics		
McFadden R2		.100
Adjusted R2		.097
Log-likelihood		-2829.960
Restricted Log-likelihood (base MNL model)		2845.285
LR statistics		30.65
Number of obs.		2588

Note: ***, **,* denotes significance at the 1%, 5%, 10% level.

The base MNL model with main effects is rejected, since the chi-squared statistic (LR statistic) for the hypothesis that the coefficients of two-way interaction variables are jointly zero is greater than the critical value $\chi 2$ (4) (13.277) at the 1% level.

Four two-way interaction terms pertaining to egg shell colour are statistically significant. The magnitude of these parameters demonstrates that shell colour does matter to respondents when choosing eggs with enhanced production methods or pasteurization. Based on the model results in Table 6-4, respondents appear to prefer cage-free eggs, which have brown shells. Shell colour

has a significant impact on respondents' preferences for free run, organic and pasteurized eggs. This confirms the expectation that consumers tend to rely on search attributes (shell colour) to help evaluate egg products with certain credence attributes (free run, organic or pasteurization).

Since the base MNL model with a set of significant two-way interaction terms significantly improves the goodness of fit, it serves as the base model for estimations of the extended MNL model and the ML model in the subsequent sections. In the following paragraphs, two alternative choice models are introduced to ascertain the presence of preference heterogeneity by relaxing the limitations of base MNL models.

Extended MNL Model with Respondents' Characteristics

In order to examine the heterogeneity of egg consumers' preferences, an MNL model that includes the socio-demographic and attitudinal characteristics of the respondents is estimated. The inclusion of individual-specific variables in the base MNL model makes it possible to account for some of the heterogeneity in the preferences between individuals. Table 6-5 illustrates the definition and coding of the variables that enter the model as covariates in the extended MNL model.

Table 6-5. Variables used in the extended MNL model

Variables	Abbreviation	Description and coding
		Covariate variables
Gender	-	=1 if the respondent is female, 0 otherwise.
Age	-	A continuous variable ranging from 18 to 87.
Urban	-	=1 if respondents live in urban area with population more than 100,000, 0 otherwise.
Income	-	Midpoint of each category of annual household income before taxes divided by 1000. For example, $35,000-$49,999 is coded as 42.5k.
British Columbia	BC	=1 if respondent lives in the province of British Columbia, 0 otherwise.
Regular	RG	=1 if respondents purchase eggs at least once per week in the past six months, 0 otherwise.
Superstore	ST	=1 if respondents buy eggs regularly in supermarkets or grocery store, 0 otherwise.
Farmers' market	FM	=1 if respondents buy eggs regularly in famers' market, 0 otherwise.
Risk preference	RISK	Summation of five 5-point Likert scale rating items associated with the likelihood of engaging in health-related behaviours ranging from 5 to 25.
Knowledge of free run eggs	KOF	Knowledge of the production method and nutritional information of free run eggs, measured by Likert scales ranging from 1 to 5 that represent from know nothing to know a lot.
Knowledge of pasteurized eggs	KOP	Knowledge of the production method and nutritional information of pasteurized eggs, measured by Likert scales ranging from 1 to 5 that represent from know nothing to know a lot.
Knowledge of organic eggs	KOO	Knowledge of the production method and nutritional information of organic eggs, measured by Likert scales ranging from 1 to 5 that represent from know nothing to know a lot.
Health attitude	HEALTH	Summation of three 5-point Likert scale rating items associated with respondents' health attitude (refer to Question 21d-21f in Section II of Appendix), ranging from 3 to 15.

Covariates were selected for the extended model if they were consistent with the priori expectation, rationale or the relevant literature review. Based on this procedure, the final model includes only those significant interaction variables between the main choice experiment variables and respondents' characteristics, as reported in Table 6-6. Others variables were omitted from the final model due to insignificance or endogeneity.

Table 6-6. Extended MNL model estimates with characteristic interaction terms

Variables	Coefficient	P-value
ASC_N	-3.442***	.000
ASC_REG	-.030	.794
PRICE	-.657***	.000
BROWN	-.418**	.042
FR	-.418*	.065
ORG	-1.265***	.000
VFR	.783*	.055
OMG-3	-.783**	.021
VITAM	.089	.311
PASTEU	-.005	.978
BROWN*FR	.415**	.045
BROWN*ORG	.993***	.000
BROWN*VFR	.427*	.093
BROWN*PASTEU	.527***	.002
GENDER*FR	.429***	.001
GENDER*ORG	.322**	.024

AGE*VFR	-.016**	.015
URBAN*ORG	.307**	.024
URBAN*VFR	.567***	.006
INCOME*PRICE	.001**	.014
BC*FR	.371**	.017
BC*VFR	.624**	.012
RG*PRICE	.167***	.000
ST*BROWN	-.390***	.005
FM*PRICE	.404***	.000
FM*FR	-1.036***	.002
RISK*PASTEU	-.056***	.000
KOF*FR	.278***	.000
KOP*PASTEU	.280***	.000
KOO*ORG	.399***	.000
HEALTH*OMG-3	.110***	.000
Summary statistics		
McFadden R2		.147
Adjusted R2		.144
Log-likelihood		-2682.182
Restricted Log-likelihood (base MNL model with two-way interaction effects)		-2829.960
LR statistics		295.556
Number of obs.		2588

Note: ***, **,* denotes significance at the 1%, 5%, 10% level.

As shown in Table 6-6, the *LR* statistic is greater than the critical values $\chi 2$ (17) (33.409) at the 1% level, suggesting the extended MNL model with covariates fits the data better than the base MNL model with two-way interaction effects. Thus, it confirms preference heterogeneity exists among egg consumers.

As expected, the coefficients on the alternative-specific constants for no option and price are negative and significant, indicating that there is positive utility associated with choosing either option A or B compared with choosing the no purchase option and that increasing prices decrease the probability of a respondent purchasing any egg type. Similar to the base MNL model with two-way interaction terms, the coefficients on four two-way interaction terms pertaining to egg shell colour are also positive and statistically significant. It should be noted that when interpreting the effects of egg attributes, it is better to compare the total effects of the main attributes on the choice decision by taking interaction effects into consideration instead of partial effects. This is because the coefficients on the covariates are statistically significant at least above the 5% level in the extended MNL model. When looking at the role of the respondents' characteristics, the estimation results should be interpreted relative to the reference group. It is evident that different covariates have different impacts on individual attributes.

Shell colour: The variable denoting whether respondents who buy eggs regularly in supermarkets/grocery store (*ST*) was the only covariate statistically significant when interacted with the shell colour (*BROWN*). The negative coefficient indicates respondents who buy eggs regularly in supermarkets/grocery stores are more likely to choose white eggs. In addition, shell colour plays a significant role in respondents' choice of eggs with enhanced production methods or pasteurization.

Production method: The interaction terms between gender and the attributes of free run and organic (*GENDER*FR* and *GENDER*ORG*) have significant and positive effects, suggesting that females in the sample have a higher likelihood of purchasing free run eggs and organic eggs relative to male counterparts. *KOF*FR* and *KOO*ORG* both have positive significant coefficients, implying that respondents who viewed themselves to be more knowledgeable about the production and nutrition of free run eggs or organic eggs are more likely to purchase those two types of eggs. With the coefficient of the interaction variable *FM*FR* being negative and significant, it suggests that respondents who buy eggs regularly in farmers' markets are less likely to choose free run eggs compared to those who never or occasionally buy eggs in farmers' markets. Unlike free run eggs, the source of respondents' preference heterogeneity for verified free run eggs is different except for the covariate of *BC*. The positive and significant coefficients of *BC*FR* and *BC*VFR* indicate that respondents from British Columbia are more likely to buy free run and verified free run eggs. In addition, the variable *AGE* shows a negative and significant impact on the evaluation of the *VFR* attribute. Thus, ceteris paribus, older consumers are generally less likely to choose verified free run eggs. The coefficients of *URBAN*VFR* and *URBAN*ORG* are positive and significant, suggesting that respondents who live in urban areas with populations more than 100,000 have a higher possibility of purchasing verified free run eggs and organic eggs relative to those who live in community with population less than 100,000. It is also notable that brown shell free run, verified free run or organic eggs are valued more by respondents compared to white shell free run, verified free run or organic eggs.

Feed: When the covariates are interacted with the vitamin-enhanced attribute, none is found to significantly interpret respondents' preference variation. For the omega-3 enhanced attribute, one interaction variable *HEALTH*OMG-3* is identified to have a significant coefficient. The

positive and significant coefficient of *HEALTH*OMG-3* indicates that respondents with heighted health consciousness are more likely to purchase omega-3 enhanced eggs. Previous studies, such as Asselin (2005), found similar results in terms of the impact of health consciousness on consumers' choice of omega-3 enhanced eggs.

Pasteurization: Two variables *RISK* and *KOP* that are interacted with *PASTEU* are estimated to be highly significant. The negative and significant coefficient of *RISK*PASTEU* indicates that respondents who are more risk-seeking have a lower intention of buying pasteurized eggs. This result is expected, since pasteurized eggs are claimed to be eggs with enhanced safety. *KOP*PASTEU* has a significant positive coefficient, implying that respondents who claimed themselves to be more knowledgeable about the production and nutrition of pasteurized eggs are more likely to purchase pasteurized eggs. On average, respondents prefer brown shell pasteurized eggs over white shell pasteurized eggs.

Price: Three interaction variables related to price carry positive and significant effects at the 1% level, including *FM*PRICE*, *INCOME*PRICE* and *RG*PRICE*. Consequently, these estimated coefficients imply that respondents who buy eggs regularly in farmers' markets are relatively less price sensitive relative to those who never or occasionally buy eggs in farmers' markets; respondents with higher income levels are less sensitive to price changes; respondents who purchase eggs regularly tend to be less responsive towards price changes in contrast with those who purchase eggs irregularly.

To sum up, it is demonstrated that the sampled respondents display distinctive preferences for egg attributes and some of their socio-demographic characteristics, knowledge and attitudes explicitly explain preference variability. However, it is suspected that only some proportion of utility variance is captured by direct incorporation of interaction terms in this model.

Consequently, it is necessary to use the ML model to further confirm the existence of preference heterogeneity and compare its explanatory power to the extended MNL model.

6.3 ML Model Results

In the ML model, the price coefficient is specified to be fixed and allow the coefficients on the remaining variables to vary with the normal distribution among the respondent population. By doing that, it is possible for the sample to have either positive or negative preferences and the mean marginal WTP estimates are ensured to be normally distributed (Louviere et al. 2000; Train 2003). The ML model is estimated by Simulated Maximum Likelihood through Halton draws with 150 replications (Revelt and Train 1998; Louviere et al. 2000; Train 2003; Hensher et al. 2005). The estimation results for the ML model are presented in Table 6-7.

Table 6-7. Simulated maximum likelihood estimates from ML model

Mean value of random parameters	Coefficients	P-value	Standard deviation coefficients	P-value
ASC_N	-8.918***	.000	4.369***	.000
ASC_REG	-.628***	.009	3.002***	.000
BROWN	-1.042***	.002	1.583***	.000
FR	1.379***	.000	1.769***	.000
ORG	-.063	.827	1.877***	.000
VFR	.618	.113	2.337***	.000
OMG-3	.670***	.000	1.114***	.000
VITAM	-.003	.988	1.045***	.000
PASTEU	-.195	.353	1.856***	.000
BROWN*FR	.206	.621	.698*	.090
BROWN*ORG	1.708***	.000	.224	.793
BROWN*VFR	-.045	.932	1.028	.101
BROWN*PASTEU	.424	.203	1.065***	.008
Mean value of fixed parameters				
Price	-1.167***	.000		
Summary statistics				
McFadden R2			.343	
Adjusted R2			.340	
Log likelihood at start values			-2829.960	
Simulated log likelihood at convergence			-2358.616	
LR statistics			942.688	
Number of obs.			2588	
Number of Halton draws			150	

Note: ***, **,* denotes significance at the 1%, 5%, 10% level. Coefficients on all variables except for price are specified as normally distributed.

As expected, the coefficients for the opt out and price are significant and negative, indicating that respondents prefer option A or B and that a price increase would lessen the probability of respondents choosing the alternatives.

Nevertheless, compared to the base MNL model estimates, the mean coefficients of several random parameters in the ML model are slightly different. For example, parameters for variables of *VFR, BROWN*FR, BROWN*PASTEU* and *BROWN*VFR* are no longer significant. Consumers are distinctly more likely to choose free run eggs and omega-3 enhanced eggs all else

being equal. They are indifferent toward verified free run eggs, vitamin-enhanced eggs and pasteurized eggs relative to regular eggs. The positive and significant coefficient of *BROWN*ORG* indicates that consumers' preference for organic eggs highly depends on the eggs' shell colour.

Given that the estimation of the ML model first involves the estimation of the base MNL model with four significant two-way interaction terms to derive initial start values for each of the parameters, the relative performance of the base MNL model and the ML model can be compared. An *LR* test is performed to examine the null hypothesis that the ML model does not significantly improve the model fit relative to the base MNL model. Since the *LR* statistic (942.688) is greater than the Chi-squared critical value $\chi 2$ (13) at the 1% level (the ML model has 13 extra parameter estimates compared to the base MNL model), the null hypothesis can be rejected and it can be concluded that the ML model fits the data better in comparison to the base MNL model that assumes fixed taste parameters.

As shown in Table 6-7, the estimated standard deviations of all random parameters on the main variables are highly significant, implying the existence of preference heterogeneity for egg attributes, including shell colour, production method, feed and pasteurization. In order to better compare the preference ordering of different types of specialty eggs, the marginal mean WTP for each type of egg is calculated and presented in Table 6-8. The estimated coefficients reported in Table 6-7 were used to compute the mean marginal WTP estimates. The standard errors are obtained by the Delta method. Note that the WTP estimates for free run, organic and pasteurized eggs are differentiated by shell colour. Results indicate that among the types of eggs with positive premiums, the highest premium is for white free run eggs, followed by omega-3 enhanced eggs, brown organic eggs and brown free run eggs compared to white regular eggs.

Table 6-8. Mean marginal WTP (in $/dozen) estimates from the ML model

Egg type	Mean marginal WTP($/1 dozen)	P-value
Brown	-.892*** (.289)	.002
White Free-run	1.182*** (.224)	.000
Brown Free-run	.466* (.261)	.074
White Organic	-.054 (.246)	.827
Brown Organic	.517* (.286)	.071
White Verified Free-run	.530 (.330)	.109
Brown Verified Free-run	-.401 (.408)	.326
Omega-3 Enhanced	.574*** (.154)	.000
Vitamin Enhanced	-.002 (.156)	.988
White Pasteurized	.167 (.179)	.352
Brown Pasteurized	-.696*** (.262)	.008

Note: ***, **,* denotes significance at the 1%, 5%, 10% level, the numbers in parentheses are standard errors generated by using delta method in NLOGIT 4.0.

It is noticeable that respondents' WTP for free run eggs, organic eggs and pasteurized eggs depends on the shell colour. On average, respondents are willing to pay a price premium of $1.18 per dozen to purchase white free run eggs, whereas their premium for the brown free run eggs is $.47 per dozen. The negative impact of shell colour on specialty eggs also applies to pasteurized eggs. There is no premium for white pasteurized eggs relative to regular eggs, whereas the mean marginal WTP for brown pasteurized eggs is -$.70 per dozen. Nevertheless, shell colour adds a positive premium to the valuation of organic eggs. Respondents apparently prefer brown organic eggs (the premium is $ .52 per dozen) over white regular eggs (the premium is zero) and are indifferent between white organic eggs and white regular eggs. The WTP difference between

certain types of white specialty eggs (free run eggs, organic eggs and pasteurized eggs) and brown counterparts may seem curious. However, it is speculated that this could be because the sampled respondents see the shell colour (search attribute) as proxy for credence attributes, since it is difficult or impossible for them to ensure the claim of credence attributes on egg products.

Consistent with the result in the base MNL model, consumers' WTP for the feed attribute varies, the mean marginal WTP for omega-3 enhanced eggs is $ .57 per dozen, whereas there is no premium for vitamin-enhanced eggs relative to regular eggs. Additionally, on average, consumers demand a discount by $ .89 per dozen for choosing brown eggs over white eggs. Finally, estimated WTP shows indifference between respondents' preferences for verified free run eggs and regular eggs.

In conclusion, the ML model results yield a more nuanced picture regarding the dispersion of preference weights among respondents. Respondents' preferences for egg attributes are found to be heterogeneous and vary across attributes. Similar to the results reported in the base MNL model with two-way interaction effects for egg attributes, shell colour is significantly valued by organic egg consumers.

6.4 Conclusion

This chapter encompasses several forms of logit model under the RUT framework, evolving from base MNL models to an array of extended discrete choice models. Instead of running separate models for both versions of the survey, the pooled model without rescaling was used for the relevant discrete choice analysis, based on data pooling tests. The result of a Wald test suggests that the introduction of verified free run eggs has a weak impact on consumers' assessment of free run eggs.

By starting with base MNL models for the pooled data set, it is initially assumed that egg consumers hold homogeneous preference for egg attributes. The estimated results indicate that

on average, respondents' WTP for different types of egg attributes significantly varied. Furthermore, results from the base MNL model with two-way interaction terms of egg attributes show that shell colour has a considerable effect on consumers' evaluation of relevant attributes.

The estimation of base MNL models, however, ignores preference heterogeneity. Therefore, two alternative choice models are introduced to account for preference heterogeneity, including an extended MNL model including interaction terms between main variables and respondents' characteristics and the ML model. These two models confirm the existence of preference heterogeneity from different perspectives. The extended MNL model results reveal factors that affect the evaluation of egg attributes and depict the profile of consumer segments. As the most generalized logit model, the ML model captures preference heterogeneity by assuming the respondent-specific parameters randomly vary according to a normal distribution instead of being fixed. In this sense, the significance of parameters relating to standard deviation of random variables confirms the existence of heterogeneity in consumers' preferences for egg shell colour, production method, feed and pasteurization.

The premium for free run eggs identified in this research is positive, which is different from the premium found in Romanowska's stated preference experiment where respondents' WTP for uncertified free run eggs is zero. With regard to the WTP estimate for pasteurized eggs, the WTP for brown pasteurized eggs is negative and significant, which is similar to the WTP estimate in Romanowska's study in which pasteurized eggs are not differentiated by shell colour. For vitamin-enhanced eggs, the identified zero premium from this research is same as that of Romanowska's study.

CHAPTER 7
CONCLUSIONS

7.1 Summary of Research Results

The core research questions in this study are to examine Canadian consumers' preferences for egg attributes and how consumers' observed characteristics and attitudes affect preference heterogeneity. A choice experiment approach and two broad categories of discrete choice models were estimated to assess consumers' preferences for egg attributes including: (1) base MNL models that assume preference homogeneity and (2) choice models that take account of preference heterogeneity.

There are several key findings identified in this study. First, base MNL model results indicate that Canadian consumers' preferences for different types of egg attributes varies significantly, and that respondents generally prefer free run eggs, followed by organic eggs and verified free run eggs and are indifferent towards brown eggs and vitamin-enhanced eggs. Second, results from the base MNL model with interaction effects suggest that shell color is related to consumers' preferences for some credence attributes (including free run, organic and pasteurization). Third, results from the extended MNL model suggest that preference heterogeneity can be systematically explained by consumers' socio-demographic information and attitudes towards egg quality. Last, estimation results from the ML model further confirm the existence of preference heterogeneity amongst Canadian consumers by capturing the variation of unobserved preference factors and allowing the individual-specific preference parameters to be normally distributed. This research found that shell colour has a significant effect on consumers' evaluation of specialty eggs with enhanced production methods or pasteurization. Overall, findings indicate that consumers place a positive premium on white free run eggs, omega-3 enhanced eggs, brown organic eggs and brown free run eggs, whereas they are indifferent

towards vitamin-enhanced eggs, verified free run eggs, white pasteurized eggs and white organic eggs. Consumers generally dislike brown eggs compared to white eggs with the exception of organic eggs.

This research differs from previous studies in terms of choice of attributes used and the correlation between egg attributes in the choice modelling. Five attributes with varying levels were chosen to reveal the difference between specialty eggs and regular eggs, thus people's preferences for certain types of specialty eggs could be decomposed into their preference for individual attributes. The wide range of attributes used in this study also enabled the analysis to account for the possible interaction between attributes, which might be masked if specialty eggs are differentiated by only a limited range of attributes. In addition, results could be applied to national consumers with the exception of Quebec instead of regionally as in previous egg studies.

7.2 Industry Implications

Despite the overall growth of the market share of specialty eggs, it is essential to understand the nature of preferences for egg attributes to further boost consumer demand for specialty eggs. To achieve this, it will be important to expand the range of egg products in existing markets to meet consumers' demands. Additionally, more knowledge is important for egg producers and retailers regarding egg characteristics and consumers' tastes.

The major findings of this research are the identification of heterogeneity in Canadian consumers' preferences toward attributes and the interaction effects between the search attribute (shell colour) and several credence attributes. Since brown organic eggs are clearly preferred over white organic eggs, egg producers can use clear plastic cartons to help consumers make purchasing decisions. Egg producers should be cautious about the decision to produce white organic eggs, since consumers might use shell colour as proxy to validate the organic claim. In

addition, even though respondents were provided with the information sheet showing the nutritional equivalence between regular eggs and free run or organic eggs, half of the respondents still think free run or organic eggs are healthier than regular eggs. Thus, an educational campaign and promotional program concerning free run and organic eggs might be more effective by emphasizing the health and taste of these eggs.

The research results are important to egg producers and other stakeholders of the egg industry in developing product differentiation strategies. Although the choice data suggest that consumers are willing to pay a premium for brown organic eggs, free run eggs and omega-3 enhanced eggs, the survey results still show that the majority of respondents still prefer regular eggs. One reason might be that the premium identified in this study for certain specialty eggs over regular eggs is lower than the actual price differentials set by the egg producers. Another reason might be that consumers are lacking knowledge and awareness of the benefits associated with specialty eggs, which makes them habitually purchase regular eggs. Therefore, it might be useful for egg marketers and producers to advertise desirable attributes of specialty eggs using a series of promotional events or campaigns, or alternative packaging strategies: e.g. free run egg packages could illustrate that eggs come from happy laying hens.

Another strategy would be for egg marketers and producers to work with animal rights groups (e.g. British Columbia Society for the Prevention of Cruelty to Animals and World Society for the Protection of Animals) to promote specialty eggs with enhanced animal welfare attributes (e.g. free run and organic eggs) to reach target customers. For specialty eggs with perceived health benefits, it might be advisable to market them through different alternative outlets such as functional food stores instead of generic grocery stores, which might help to target health-conscious consumers. Since some consumers perceive free run and organic eggs as healthier and

better tasting, in spite of information provided that explains free run and organic eggs have the same nutritional components as regular eggs, egg marketing strategies could emphasize desirable features of health and taste regarding free run and organic eggs to expand the targeted niche market. For example, marketers could develop an on-site tasting campaign.

To sum up, the identification of preference heterogeneity and determining factors amongst Canadian egg consumers can not only help egg marketers and policy makers to lay out relevant educational and marketing plans to sustain the further development of egg sectors, but also satisfy consumers' unique preferences by providing quality-differentiated products with unique features or characteristics. However, care should be exercised if free run egg verification is to be introduced into the niche market of free run eggs given the potential existence of the externality effect. The research finding indicates that the introduction of the verified free run attribute might have adverse effect on consumers' evaluation of free run without verification. Consequently, welfare or benefit-cost analysis might be required to evaluate the influence of verification policies on preferences for a set of credence attributes. In addition, findings concerning the interaction of attributes might imply that shell colour could be used by the egg industry to send positive quality signals about credence attributes.

7.3 Limitations of the Research and Areas for Future Research

While this research provides valid results about respondents' preferences for specialty eggs, there are several limitations. First, the model estimates might be sensitive to the number of attributes and levels of attributes. Thus, future research would be beneficial to examine the effect of the number of attributes or attribute levels on marginal WTP estimates. Second, survey subjects are only those who personally purchased eggs for their household to eat at home, and therefore might not be representative of Canadian egg consumers as a whole. In addition, it is of note that the sample omitted the province of Quebec in which consumers might have different

preferences for egg attributes from the rest of Canada. Third, although the choice experiment is beneficial because it enables researchers to manipulate product attributes and develop product choices that do not exist in the grocery store, it has limitations because of the nature of the stated preference method. Therefore, it ought to be acknowledged that the stated choice experiment results might be subject to hypothetical bias (people are prone to overstating their WTP for choices without being faced with choices for real products in a real shopping experience). Hence, future research could be conducted to compare marginal WTP estimates in a hypothetical setting versus in a non-hypothetical setting.

In addition, as more varied specialty eggs emerge in the Canadian market, it might be possible for prospective researchers to use revealed preference experiments to conduct similar research to investigate consumers' WTP for egg attributes in an actual purchasing setting. Last, as the choice experiment does not take into account the alternative verification policies when investigating the externality effect, it might be worthwhile to examine how alternative verification institutions influence consumers' valuation of free run eggs.

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APPENDIX

Egg Survey

You are invited to participate in a research study related to egg consumption. The survey will take approximately 20-30 minutes to complete. By participating in this study you may help us gain a greater understanding of issues surrounding egg consumption.

The research involves a web-based online survey about the choices you make when purchasing eggs. Your participation is voluntary and you are free to withdraw from the survey at any time. Should you do so, the questions that you have answered prior to your withdrawal will be completely deleted. All responses to this questionnaire are anonymous; the researchers will not be able to identify you in any way with your answers. There is no risk to participating in this survey since no results will be identified at the individual level.

If you are interested in learning more about this study, please contact the researchers Dr. Jing Zhang or Liou Huang using the contact information below. This study was approved by the Behavioural Research Ethics Board at the University of Saskatchewan on September 14, 2010. For more details on this you may contact the University of Saskatchewan Research Ethics office at (306) 966-2975. Thank you for considering this request, your participation is invaluable to the research process.

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Consent to Participate:

I have read and understood the description provided above. I consent to participate in the study, understanding that I may withdraw my consent at any time while completing the online survey.

- ☐ Yes, start the survey
- ☐ No, decline the survey

Have you personally purchased eggs for your household to eat at home in the past six months?

- ☐ Yes
- ☐ No

Please select the region you live in.

- ☐ Maritimes
- ☐ Ontario
- ☐ Manitoba/Saskatchewan
- ☐ Alberta
- ☐ British Columbia

Canadian Consumer Egg Consumption Survey

This survey has two sections. You will be first asked to complete some choice tasks and then you will be asked to answer a series of questions related to egg consumption.

Section I

In this section, we would appreciate it if you would complete the following choice-related tasks. In each choice-related task, you will be asked to choose your most preferred carton containing 1 dozen (12) eggs from a choice of three cartons of Canada Grade A large eggs. Alternative cartons of eggs may vary in their shell colour, the way hens are housed and raised, the type of feed fed to the hens, whether a pasteurization process is applied, and price. Although many of the questions may look similar, your answers are helping us in our research.

Detailed information about the different options in the choice task is provided below.

Version 1:

Shell colour

- Eggs have either *brown* or *white* shell colours.

Production method

- *Conventional* battery *cages*: hens are kept in conventional battery cages.

- Free run: hens are able to move about the floor of the barn and have access to nesting boxes and, quite often, perches.

- *Organic*: hens must be raised by certified organic production methods from birth. The hens are required to have outdoor access year round. All feed must be certified organic as well. No antibiotics or animal by-products are allowed in the feed.

Feed

- *Regular feed*: a diet that is widely used in the current poultry industry in Canada. It must not contain ingredients that can cause illness or suffering in hens, but may contain animal proteins or by-products as a protein source.

- *Omega-3* enhanced *feed*: a diet that contains 10 to 20 per cent flaxseed. As a result, the eggs produced will contain higher levels of omega-3 polyunsaturated fatty acids than eggs of hens that are fed regular feed.

- *Vitamin*-enhanced *feed*: a nutritionally-enhanced diet containing higher levels of certain nutrients (e.g., vitamin E, folate, vitamin B6 and vitamin B12). As a result, the eggs produced will contain higher levels of these nutrients than eggs of hens that are fed regular feed.

Pasteurization

- In-shell pasteurized eggs use a patented, all-natural pasteurization process to eliminate bacteria without cooking the eggs. Currently, eggs sold in Canada are not pasteurized.

- Some eggs in this study are not pasteurized, while some eggs are pasteurized.

Nutritional value of a Canadian Grade A large egg:

- Regular eggs are produced using conventional battery caged methods. The nutritional value of a regular Canadian Grade A large egg (53 g) is shown below. Free-run and organic eggs have the *same* nutritional value as regular eggs unless the feed is enhanced with higher levels of flaxseed or vitamins.

Nutrition Facts
Valeur nutritive

Per 1 large egg (53 g) / pour 1 gros œuf (53 g)

Amount Teneur	% Daily Value % valeur quotidienne
Calories / Calories 70	
Fat / Lipides 5 g	**8** %
Saturated / saturés 1.5 g + trans / trans 0 g	**8** %
Cholesterol / Cholestérol 195 mg	
Sodium / Sodium 65 mg	**3** %
Carbohydrate / Glucides 1 g	**1** %
Fibre / Fibres 0 g	**0** %
Sugars / Sucres 0 g	
Protein / Protéines 6 g	
Vitamin A / Vitamine A	10 %
Vitamin C / Vitamine C	0 %
Calcium / Calcium	2 %
Iron / Fer	6 %

1.1 During a typical shopping trip to the grocery store where you purchase eggs, if the following options were the only ones available (1 dozen carton of Canadian Grade A large eggs), which option would you purchase?

Detailed info

	Option A	**Option B**	**Option C**	**Option D**
Shell colour	White	Brown	White	I wouldn't buy any
Production method	Free run	Conventional Battery cage	Conventional Battery cage	
Feed	Regular feed	Omega-3 enhanced feed	Regular feed	
Pasteurization	Not Pasteurized	Pasteurized	Not Pasteurized	
Price	$3.43	$2.15	$2.15	
I choose	☐ **Option A**	☐ **Option B**	☐ **Option C**	☐ **Option D**

1.2 How certain or confident are you about the decision you made? Please rate your confidence using a scale from 1 to 10. For example, "10" means you are 100% percent sure that the one you chose is your most preferred option, while "1"means you are not sure about the decision your made.

No confidence at all									**Complete confidence**
1	2	3	4	5	6	7	8	9	10

2.1 During a typical shopping trip to the grocery store where you purchase eggs, if the following options were the only ones available (1 dozen carton of Canadian Grade A large eggs), which option would you purchase?

Detailed info

	Option A	**Option B**	**Option C**	**Option D**
Shell colour	Brown	White	White	I wouldn't buy any
Production method	Conventional Battery cage	Free run	Conventional Battery cage	
Feed	Vitamin-enhanced feed	Regular feed	Regular feed	
Pasteurization	Pasteurized	Not Pasteurized	Not Pasteurized	
Price	$2.15	$5.99	$2.15	
I choose	☐ **Option A**	☐ **Option B**	☐ **Option C**	☐ **Option D**

2.2 How certain or confident are you about the decision you made? Please rate your confidence using a scale from 1 to 10. For example, "10" means you are 100% percent sure that the one you chose is your most preferred option, while "1"means you are not sure about the decision your made.

No confidence at all									**Complete confidence**
1	2	3	4	5	6	7	8	9	10

3.1 During a typical shopping trip to the grocery store where you purchase eggs, if the following options were the only ones available (1 dozen carton of Canadian Grade A large eggs), which option would you purchase?

Detailed info

	Option A	**Option B**	**Option C**	**Option D**
Shell colour	White	Brown	White	I wouldn't buy any
Production method	Conventional Battery cage	Organic	Conventional Battery cage	
Feed	Vitamin-enhanced feed	Omega-3 enhanced feed	Regular feed	
Pasteurization	Pasteurized	Not Pasteurized	Not Pasteurized	
Price	$5.99	$4.71	$2.15	
I choose	☐ **Option A**	☐ **Option B**	☐ **Option C**	☐ **Option D**

3.2 How certain or confident are you about the decision you made? Please rate your confidence using a scale from 1 to 10. For example, "10" means you are 100% percent sure that the one you chose is your most preferred option, while "1"means you are not sure about the decision your made.

No confidence at all									**Complete confidence**
1	2	3	4	5	6	7	8	9	10

4.1 During a typical shopping trip to the grocery store where you purchase eggs, if the following options were the only ones available (1 dozen carton of Canadian Grade A large eggs), which option would you purchase?

Detailed info

	Option A	**Option B**	**Option C**	**Option D**
Shell colour	White	Brown	White	I wouldn't buy any
Production methods	Organic	Free run	Conventional Battery cage	
Feed	Omega-3 enhanced feed	Vitamin-enhanced feed	Regular feed	
Pasteurization	Not Pasteurized	Pasteurized	Not Pasteurized	
Price	$4.71	$3.43	$2.15	
I choose	☐ **Option A**	☐ **Option B**	☐ **Option C**	☐ **Option D**

4.2 How certain or confident are you about the decision you made? Please rate your confidence using a scale from 1 to 10. For example, "10" means you are 100% percent sure that the one you chose is your most preferred option, while "1"means you are not sure about the decision your made.

No confidence at all									**Complete confidence**
1	2	3	4	5	6	7	8	9	10

5 Recall how you made the above choices; please indicate how well the following descriptions match your decision strategy.

	Strongly disagree	**Disagree**	**Neither agree, nor disagree**	**Agree**	**Strongly agree**
	1	**2**	**3**	**4**	**5**
a) I was looking for the best deal for my money.	☐	☐	☐	☐	☐
b) I always buy regular eggs (battery caged produced eggs) no matter what.	☐	☐	☐	☐	☐
c) I didn't buy any pasteurized eggs because I have not had them before.	☐	☐	☐	☐	☐
d) I don't care how the hens were housed.	☐	☐	☐	☐	☐
e) I don't care what the hens were fed.	☐	☐	☐	☐	☐
f) I am more likely to buy verified free run eggs or organic eggs because of the quality assurance guaranteed by the verification or certification process.	☐	☐	☐	☐	☐

Version 2:

Shell colour

- Eggs have either *brown* or *white* shell colours.

Production method

- *Conventional* battery *cages*: hens are kept in conventional battery cages.

- *Free run*: hens are able to move about the floor of the barn and have access to nesting boxes and, quite often, perches. Housing systems for free-run are *not* audited or third-party verified.

- *Verified free run*: hens are able to move about the floor of the barn and have access to nesting boxes and, quite often, perches. A third party auditor verifies the process.

- *Organic*: hens must be raised by certified organic production methods from birth. The hens are required to have outdoor access year round. All feed must be certified organic as well. No antibiotics or animal by-products are allowed in the feed. Organic eggs are subject to a third party audit or verification.

Feed

- *Regular feed*: a diet that is widely used in the current poultry industry in Canada. It must not contain ingredients that can cause illness or suffering in hens, but may contain animal proteins or by-products as a protein source.

- *Omega-3 enhanced feed*: a diet that contains 10 to 20 per cent flaxseed. As a result, the eggs produced will contain higher levels of omega-3 polyunsaturated fatty acids than eggs of hens that are fed regular feed.

- Vitamin-*enhanced feed*: a nutritionally-enhanced diet containing higher levels of certain nutrients (e.g., vitamin E, folate, vitamin B6 and vitamin B12). As a result, the eggs produced will contain higher levels of these nutrients than eggs of hens that are fed regular feed.

Pasteurization

- In-shell pasteurized eggs use a patented, all-natural pasteurization process to eliminate bacteria without cooking the eggs. Currently, eggs sold in Canada are not pasteurized.

- Some eggs in this study are not pasteurized, while some eggs are pasteurized.

Nutritional value of a Canadian Grade A large egg:

- Regular eggs are produced using conventional battery caged methods. The nutritional value of a regular Canadian Grade A large egg (53 g) is shown

below. Free-run and organic eggs have the *same* nutritional value as regular eggs unless the feed is enhanced with higher levels of flaxseed or vitamins.

Nutrition Facts
Valeur nutritive

Per 1 large egg (53 g) / pour 1 gros œuf (53 g)

Amount Teneur	% Daily Value % valeur quotidienne
Calories / Calories 70	
Fat / Lipides 5 g	**8** %
Saturated / saturés 1.5 g + trans / trans 0 g	**8** %
Cholesterol / Cholestérol 195 mg	
Sodium / Sodium 65 mg	**3** %
Carbohydrate / Glucides 1 g	**1** %
Fibre / Fibres 0 g	**0** %
Sugars / Sucres 0 g	
Protein / Protéines 6 g	
Vitamin A / Vitamine A	10 %
Vitamin C / Vitamine C	0 %
Calcium / Calcium	2 %
Iron / Fer	6 %

1.1 During a typical shopping trip to the grocery store where you purchase eggs, if the following options were the only ones available (1 dozen carton of Canadian Grade A large eggs), which option would you purchase?

Detailed info

	Option A	**Option B**	**Option C**	**Option D**
Shell colour	White	Brown	White	I wouldn't buy any
Production method	Organic	Free run	Conventional Battery cage	
Feed	Omega-3 enhanced feed	Regular feed	Regular feed	
Pasteurization	Not Pasteurized	Pasteurized	Not Pasteurized	
Price	$2.15	$4.71	$2.15	
I choose	☐ **Option A**	☐ **Option B**	☐ **Option C**	☐ **Option D**

1.2 How certain or confident are you about the decision you made? Please rate your confidence using a scale from 1 to 10. For example, "10" means you are 100% percent sure that the one you chose is your most preferred option, while "1"means you are not sure about the decision your made.

No confidence at all									**Complete confidence**
1	2	3	4	5	6	7	8	9	10

2.1 During a typical shopping trip to the grocery store where you purchase eggs, if the following options were the only ones available (1 dozen carton of Canadian Grade A large eggs), which option would you purchase?

Detailed info

	Option A	**Option B**	**Option C**	**Option D**
Shell colour	Brown	White	White	I wouldn't buy any
Production method	Free run	Conventional Battery cage	Conventional Battery cage	
Feed	Regular feed	Omega-3 enhanced feed	Regular feed	
Pasteurization	Pasteurized	Not Pasteurized	Not Pasteurized	
Price	$4.71	$2.15	$2.15	
I choose	☐ **Option A**	☐ **Option B**	☐ **Option C**	☐ **Option D**

2.2 How certain or confident are you about the decision you made? Please rate your confidence using a scale from 1 to 10. For example, "10" means you are 100% percent sure that the one you chose is your most preferred option, while "1"means you are not sure about the decision your made.

No confidence at all									**Complete confidence**
1	2	3	4	5	6	7	8	9	10

3.1 During a typical shopping trip to the grocery store where you purchase eggs, if the following options were the only ones available (1 dozen carton of Canadian Grade A large eggs), which option would you purchase?

Detailed info

	Option A	**Option B**	**Option C**	**Option D**
Shell colour	Brown	White	White	I wouldn't buy any
Production method	Free run	Organic	Conventional Battery cage	
Feed	Regular feed	Regular feed	Conventional feed	
Pasteurization	Pasteurized	Pasteurized	Not Pasteurized	
Price	$4.71	$5.99	$2.15	
I choose	☐ **Option A**	☐ **Option B**	☐ **Option C**	☐ **Option D**

3.2 How certain or confident are you about the decision you made? Please rate your confidence using a scale from 1 to 10. For example, "10" means you are 100% percent sure that the one you chose is your most preferred option, while "1"means you are not sure about the decision your made.

No confidence at all									**Complete confidence**
1	2	3	4	5	6	7	8	9	10

4.1 During a typical shopping trip to the grocery store where you purchase eggs, if the following options were the only ones available (1 dozen carton of Canadian Grade A large eggs), which option would you purchase?

Detailed info

	Option A	**Option B**	**Option C**	**Option D**
Shell colour	White	Brown	White	I wouldn't buy any
Production methods	Organic	Verified free run	Conventional Battery cage	
Feed	Regular feed	Omega-3 enhanced feed	Regular feed	
Pasteurization	Not Pasteurized	Pasteurized	Not Pasteurized	
Price	$3.43	$5.99	$2.15	
I choose	☐ **Option A**	☐ **Option B**	☐ **Option C**	☐ **Option D**

4.2 How certain or confident are you about the decision you made? Please rate your confidence using a scale from 1 to 10. For example, "10" means you are 100% percent sure that the one you chose is your most preferred option, while "1"means you are not sure about the decision your made.

No confidence at all									**Complete confidence**
1	2	3	4	5	6	7	8	9	10

5 Recall how you made the above choices; please indicate how well the following descriptions match your decision strategy.

	Strongly disagree	**Disagree**	**Neither agree, nor disagree**	**Agree**	**Strongly agree**
	1	**2**	**3**	**4**	**5**
a) I was looking for the best deal for my money.	☐	☐	☐	☐	☐
b) I always buy regular eggs (battery caged produced eggs) no matter what.	☐	☐	☐	☐	☐
c) I didn't buy any pasteurized eggs because I have not had them before.	☐	☐	☐	☐	☐
d) I don't care how the hens were housed.	☐	☐	☐	☐	☐
e) I don't care what the hens were fed.	☐	☐	☐	☐	☐
f) I am more likely to buy verified free run eggs or organic eggs because of the quality assurance guaranteed by the verification or certification process.	☐	☐	☐	☐	☐

Section II

Please answer the following questions to the best of your knowledge.

1. How often did you purchase eggs in the past six months? (Check One)

☐	1.	Less often than once every six months
☐	2.	Less than once a month but more than once every six
☐	3.	About 1-2 times per month
☐	4.	About once per week
☐	5.	More than once per week

2. Where do you usually buy eggs?

	Never	**Occasionally**	**Regularly**
	1	**2**	**3**
Supermarkets/Grocery store	☐	☐	☐
Farmers' market	☐	☐	☐
Other (specify)	☐	☐	☐

3. What is the package size of eggs you most frequently purchase? (Check One Only)

☐	1.	6 egg carton (half a dozen)
☐	2.	12 egg carton (1 dozen)
☐	3.	18 egg carton (1.5 dozen)
☐	4.	Egg tray that holds about 20 to 30 eggs
☐	5.	Other:_____

4. To the best of your knowledge, how much do you usually pay per package of eggs for the most common package type that you purchase? (Check one)

☐	1.	$1.00 - $1.99
☐	2.	$2.00 - $2.99
☐	3.	$3.00 - $3.99
☐	4.	$4.00 - $4.99
☐	5.	$5.00 - $5.99
☐	6.	$6.00 or more
☐	7.	Don't know

5. To the best of your knowledge, what colour of eggs do you normally buy? (Check one)

☐	1.	White
☐	2.	Brown
☐	3.	Both (about half-half)
☐	4.	Don't know

6. What type of eggs do you normally buy? (Check all that apply)

☐	1.	Regular eggs
☐	2.	Omega-3 enhanced eggs
☐	3.	Free run eggs
☐	4.	Organic eggs
☐	5.	Vitamin-enhanced eggs
☐	6.	Other eggs

6a. [If more than one selected in Q6] **What type of eggs do you buy most often?**		
☐	1.	Regular eggs
☐	2.	Omega-3 enhanced eggs
☐	3.	Free run eggs
☐	4.	Organic eggs
☐	5.	Vitamin-enhanced eggs
☐	6.	Other eggs

7. Please indicate to what extent you agree/disagree with the following statements.

	Strongly disagree	**Disagree**	**Neither agree, nor disagree**	**Agree**	**Strongly agree**
	1	**2**	**3**	**4**	**5**
a) Generally, food products are safe.	☐	☐	☐	☐	☐
b) I am satisfied with the safety of food products.	☐	☐	☐	☐	☐
c) I am suspicious about certain food products as a result of the occurrence of food safety incidents (e.g., Ecoli or Salmonella contaminated food).	☐	☐	☐	☐	☐

8. Please indicate how much confidence you generally have in the safety of the following product groups if they are purchased from a superstore/grocery store. [randomize order]

	No confidence at all 1	2	3	4	Complete confidence 5
a) Regular Eggs	☐	☐	☐	☐	☐
b) Organic eggs	☐	☐	☐	☐	☐
c) Free run eggs	☐	☐	☐	☐	☐
d) Pork	☐	☐	☐	☐	☐
e) Chicken	☐	☐	☐	☐	☐
f) Beef	☐	☐	☐	☐	☐
g) Fish	☐	☐	☐	☐	☐

9. To what extent do you think the following is/are responsible for the safety of food?

	Not at all responsible 1	2	3	4	Responsible to a great extent 5
a) Food manufacturers	☐	☐	☐	☐	☐
b) Grocery stores/retailers	☐	☐	☐	☐	☐
c) Government (Canadian Food Inspection Agency)	☐	☐	☐	☐	☐
d) Farmers	☐	☐	☐	☐	☐

10. Imagine that there is a food safety scandal concerning egg production in Canada. To what extent do you think the following is/are most likely to be responsible for the incident?

	Very unlikely	Somewhat unlikely	Neutral	Somewhat likely	Very likely
	1	2	3	4	5
a) Food manufacturers	☐	☐	☐	☐	☐
b) Grocery stores/retailers	☐	☐	☐	☐	☐
c) Government (Canadian Food Inspection Agency)	☐	☐	☐	☐	☐
d) Farmers	☐	☐	☐	☐	☐

11. To what extent do you agree or disagree with the following statements?

	Strongly disagree	Disagree	Neither agree, nor disagree	Agree	Strongly agree
	1	2	3	4	5
a) When eating eggs, I am exposed to little risk.	☐	☐	☐	☐	☐
b) For me, eating eggs is worth the risk.	☐	☐	☐	☐	☐
c) A serving of one or two eggs per day is part of a healthy eating	☐	☐	☐	☐	☐
d) I think eating eggs on a daily basis may expose me to a higher risk of heart disease.	☐	☐	☐	☐	☐
e) I eat fewer eggs due to a concern about my cholesterol level.	☐	☐	☐	☐	☐
f) I eat fewer eggs than I did a few years ago.	☐	☐	☐	☐	☐

12. We would like to know your opinions on the following activities or behaviours. Please indicate how likely you would be to engage in the following activities or behaviours. [randomize order]

	Very unlikely	Somewhat unlikely	Neutral	Somewhat likely	Very likely
	1	**2**	**3**	**4**	**5**
a) ___	Eating 'expired' food products that still 'look okay'.				
b) ___	Ignoring some persistent physical pain by not going to the doctor.				
c) ___	Taking a medical drug that has a high likelihood of negative side effects.				
d) ___	Never using sunscreen when you sunbathe.				
e) ___	Regularly riding your bicycle without a helmet.				
f) ___	Periodically engaging in a dangerous sport (e.g. sky diving).				
g) ___	Going down a ski run that is too hard or closed.				
h) ___	Traveling on a commercial airplane.				
i) ___	Going on a two-week vacation in a foreign country without booking accommodations ahead.				

13. Please rate your knowledge of the production method and nutritional information of the following types of eggs.

	Know nothing				**Know a lot**
	1	**2**	**3**	**4**	**5**
a) Regular eggs	☐	☐	☐	☐	☐
b) Free run eggs	☐	☐	☐	☐	☐
c) Pasteurized eggs	☐	☐	☐	☐	☐
d) Organic eggs	☐	☐	☐	☐	☐
e) Omega-3 enhanced eggs	☐	☐	☐	☐	☐
f) Vitamin-enhanced eggs	☐	☐	☐	☐	☐
g) Eggs from hens fed only vegetarian feed	☐	☐	☐	☐	☐

14. Please indicate how likely you would be to buy or buy more of the following eggs if they become available or more available in superstores/grocery stores.

	Very unlikely				Very likely
	1	**2**	**3**	**4**	**5**
a) Free run eggs	☐	☐	☐	☐	☐
b) Pasteurized eggs	☐	☐	☐	☐	☐
c) Organic eggs	☐	☐	☐	☐	☐
d) Omega-3 enhanced eggs	☐	☐	☐	☐	☐
e) Vitamin-enhanced eggs	☐	☐	☐	☐	☐
f) Eggs from hens fed only vegetarian feed	☐	☐	☐	☐	☐

15. Please indicate how likely you would be to buy or buy more of the following eggs if their production processes are verified or certified by a third-party organization.

	Very unlikely				Very likely
	1	**2**	**3**	**4**	**5**
a) Free run eggs	☐	☐	☐	☐	☐
b) Omega-3 enhanced eggs	☐	☐	☐	☐	☐
c) Vitamin-enhanced eggs	☐	☐	☐	☐	☐
d) Eggs from hens fed only vegetarian feed	☐	☐	☐	☐	☐

16. Have you previously heard of recent egg recall in the United States last August?

☐ Yes

☐ No

17. Please indicate who is responsible for setting the following standards or regulations.

	Government	Private industry	Don't know
a) Quality standards for eggs such as Canada Grade A large	☐	☐	☐
b) Standards for nutritional claims such as "vitamin-enhanced"	☐	☐	☐
c) Standards for the pasteurization process	☐	☐	☐
d) Housing standards such as free fun	☐	☐	☐

18. Please indicate whether or not you agree with the following statements:

	Yes	No	Don't know
a) Brown eggs are more nutritious than white eggs.	☐	☐	☐
b) Eggs with a darker yolk colour have higher nutritional value.	☐	☐	☐
c) Eggs with a darker yolk colour taste better.	☐	☐	☐
d) Free run eggs have brown shells.	☐	☐	☐
e) Free run or organic eggs are healthier than regular eggs.	☐	☐	☐
f) Free run and organic eggs are more likely to be contaminated by salmonella bacteria.	☐	☐	☐
g) Organic eggs have a higher nutritional value than regular eggs.	☐	☐	☐
h) Free run or organic eggs taste better than regular	☐	☐	☐

eggs.			
i) Pasteurized eggs are safer than regular eggs.	☐	☐	☐
j) Mishandling of eggs at home was the major reason for 2010 salmonella outbreak caused by tainted eggs in the US.	☐	☐	☐

19. Have you been involved in any of the following situations in the past twelve months?

	Yes	**No**	**Don't know**
a) Complained to a retailer about food quality	☐	☐	☐
b) Refused to buy certain food types or brands in order to express your opinion on a political or social issue	☐	☐	☐
c) Participated in organised consumer boycotts	☐	☐	☐

20. Have you or anyone in your family (including all household members, children, siblings and parents) ever been diagnosed with the following health conditions? [multi-select]

a) Food allergy	☐
b) Heart disease	☐
c) High blood pressure	☐
d) High cholesterol level	☐
e) Cancer	☐
f) None of above [exclusive selection]	☐

21. To what extent do you agree or disagree with the following statements?

	Strongly disagree	Disagree	Neither agree, nor disagree	Agree	Strongly agree
	1	2	3	4	5
a) Exercising on a regular basis as an important part of my routine.	☐	☐	☐	☐	☐
b) Regularly taking vitamin supplements is an important part of my health practices.	☐	☐	☐	☐	☐
c) I habitually read nutrition labelling information on prepackaged foods if I have never had them before.	☐	☐	☐	☐	☐
d) Compared to others my age, my health is much better.	☐	☐	☐	☐	☐
e) I am knowledgeable about health and nutrition.	☐	☐	☐	☐	☐
f) It is important to eat foods that are enriched with added vitamins or with ingredients like Omega-3 fatty acids.	☐	☐	☐	☐	☐

g) Having regular contact with my physician is the best way for me to avoid illness.	☐	☐	☐	☐	☐
h) If I take care of myself, I can avoid illness.	☐	☐	☐	☐	☐
i) My good health is largely a matter of good fortune.	☐	☐	☐	☐	☐

22. Are you male or female?

☐ Male

☐ Female

23. What is your age?

_____(years)

24. Including yourself, how many people live in your household? (Check one)

☐ 1

☐ 2

☐ 3

☐ 4

☐ 5 or more

24a. [If 2 or more in Q24] **How many children younger than 18 live in your house? (Check one)**

- ☐ 0
- ☐ 1
- ☐ 2
- ☐ 3 or more

25. What is your marital status? (Check one)

- ☐ Married/Living with a partner/Common Law
- ☐ Single/Widowed

26. Do you smoke?

- ☐ Yes
- ☐ No

27. Which of the following best describes your community? (Check one)

- ☐ Rural area, population under 1,000
- ☐ Small urban area with population between 1,000 - 29,999
- ☐ Urban area with population between 30,000 - 99,999
- ☐ Urban area with population between 100,000 - 499,999
- ☐ Large urban area with population of over 500,000

28. Are you a member of an animal welfare organization?

- ☐ Yes
- ☐ No

29. What is the highest level of education you've achieved? (Check one)

- ☐ Some high school
- ☐ Completed high school
- ☐ Some post-secondary training but did not complete
- ☐ Completed technical school or college diploma
- ☐ University undergraduate or graduate degree
- ☐ Other:_____

30. Which of the following best describes your employment status? (Check one)

- ☐ Employed full-time or self-employed
- ☐ Employed part-time
- ☐ Homemaker or on leave from working
- ☐ Student
- ☐ Retired
- ☐ Unemployed and seeking employment
- ☐ Other:_____

31. Which one of the following best describes your annual household income level before taxes? (Check one)

- ☐ Under $20,000
- ☐ $20,000 - $34,999
- ☐ $35,000 - $49,999
- ☐ $50,000 - $64,999
- ☐ $65,000 - $79,999
- ☐ $80,000 - $94,999
- ☐ $95,000 - $109,999
- ☐ $110,000 - $124,999
- ☐ $125,000 or more

32. Please provide the first 3 digits of your home postal code

_____